The Electrical Industry's Weekly Magazine

April 11, 1960

Electrical World

Price 50 Cents

A McGraw-Hill Publication

Research & Development Spark Industry Breakthroughs

...page 49

FPC States Views About Contacts...p 42

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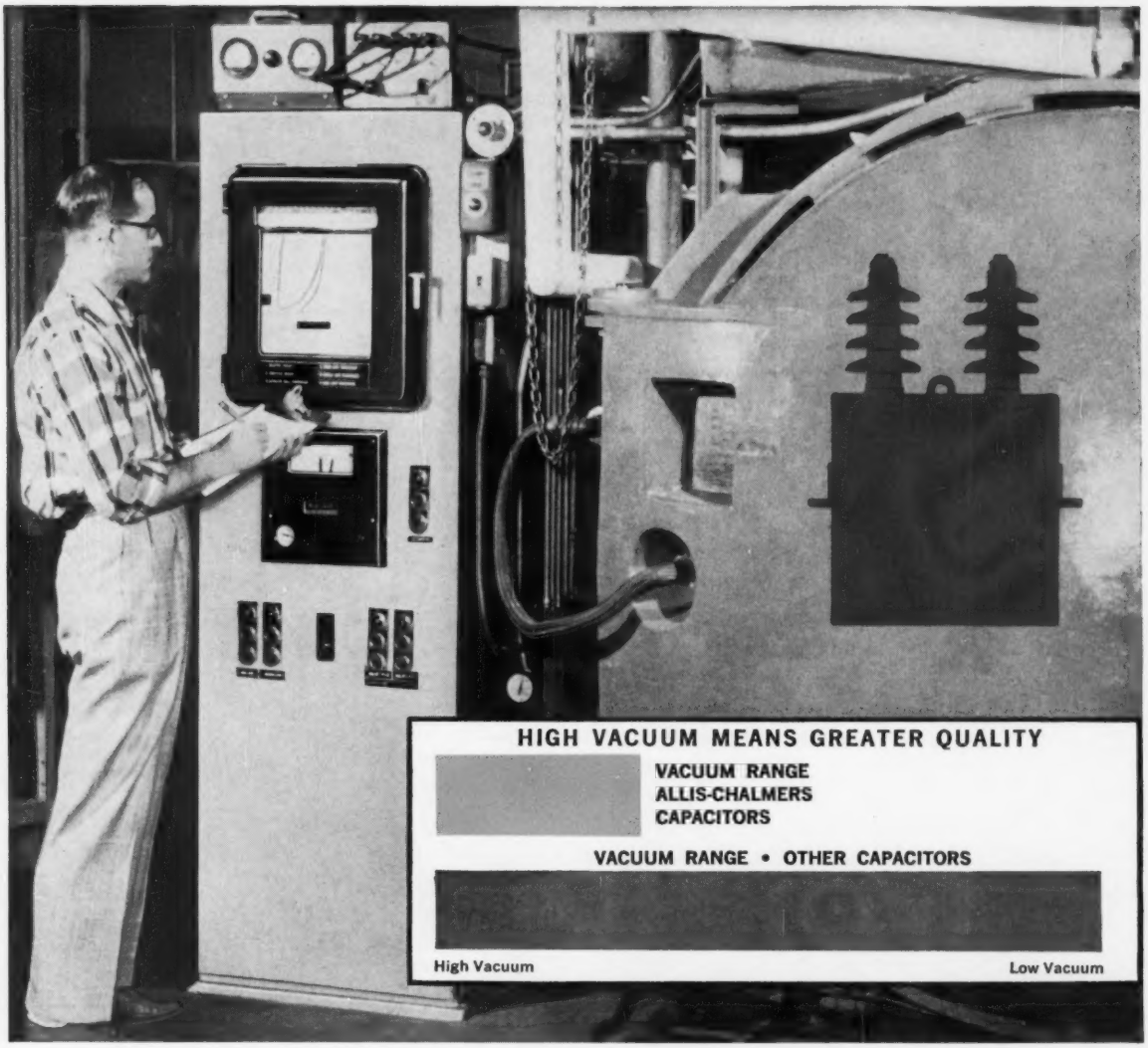

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Electrical World

Vol. 153, No. 15 APRIL 11, 1960

Published for 86 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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Utilities Eye Fuel Plans Through 1965

Coal to hold its two-thirds grip on industry, but gas will make biggest percent gains. Straggler: Oil.....p 105

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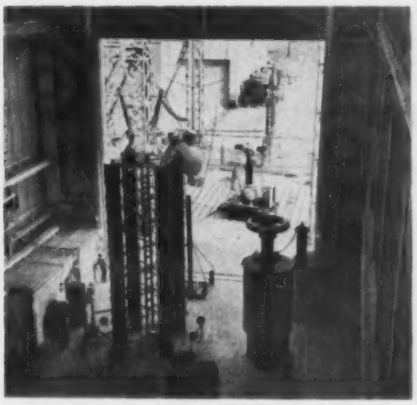

R&D Spark Breakthroughs

Special 20-page report surveys research and development activities of the electrical industry and evaluates them for probable impact on utility practices.

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AFTER 30 YEARS ON THE JOB . . . Okolite insulation still looks good. This unretouched photograph shows a section of 11.5 Kv power cable recently re-assigned by Duquesne Light Company. Note that the insulation is still flexible and resilient—workable. Tests made this year show the tensile strength has deteriorated very little, remaining more than 33% above the original specification figure.

30-year-old Okonite cable still tests above specification figures . . .

This is CABLE'BILITY *a new word for your vocabulary*

Cable'bility (cā'ble·bil'·i·ty) *new word. Noun.* **1.** Ability to design and manufacture electrical cables that give outstanding performance. **2.** Having long background and wide experience in cable research and application. **3.** Possessing keen understanding of customers' problems. Implies eagerness to serve faithfully and dedication to progress. **Syn.** The Okonite Company.

This is Okonite Cable'bility at work. It's "Old Faithful"—a 1250 MCM, Okolite-insulated power cable made in 1929, now carrying on a new career as a mine power feeder for Duquesne Light of Pittsburgh.

"Old Faithful" began service as an 11.5 Kv lead from switchyard to transformer, handling 15,000 KVA loads. During World War II, it saw fifteen years of full load operation, 24 hours a day. Then in 1957 it was replaced with a larger cable to handle even greater loads. But it was found still suitable for demanding tasks as a power feeder.

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***where there's electrical power . . . there's* OKONITE CABLE**

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LETTERS

The Electrifying Sixties?

To the Editor:

At the beginning of each new decade there ensues the search for a catchy and attention-getting popular name for the period ahead.

Various names for the present decade are now being used. One example is "The Golden Sixties." Perhaps that is supposed to denote that we are all going to get rich and that's kind of a nice feeling. I doubt that it was intended as being descriptive of a period comparable to the golden age of arts and literature of classic Greece.

I notice that Edison Electric Institute used "Electricity Sparks the '60's" as the theme for National Electrical Week. That really wasn't intended as a name for a period. Instead it expressed the hope of we in the industry that electricity will provide the source of power for these years. . . .

I believe there is a descriptive name for this period that would be helpful to our industry—one that holds some possibilities for being used broadly even by people outside of our industry. It would be especially valuable if editorial writers generally were to gravitate towards that name—and properly handled—this is not beyond the bounds of possibility.

Wouldn't it be wonderful if the American public became sold on the idea that we are now in the period of "The Electrifying Sixties"?

At any rate, that is my contribution for the morning.

Ralph Z. Sorenson, Manager
Utility Sales Dept
Westinghouse Electric Corp
Mansfield, Ohio

Second Look at Chattanooga Operations

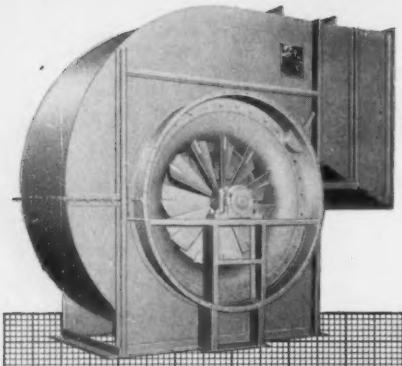
To the Editor:

The article in the Feb. 4 Public Utilities Fortnightly "Socialism and Crabgrass" by Joseph Pahle, which you quoted as "a look at the operations of the Electric Power Board of Chattanooga" (EW, Feb. 8, p 22) might more nearly be entitled "Pahle's Protestations.". . . Most of the misstatements which he makes have appeared before, and the whole article is largely a rehash. . . . Normally we pay no attention to these continuing misstatements. . . .

However, in view of the prominence which Electrical World gave to some of the many misstatements made about our policies, we feel you should be given the correct facts about them. You, yourself, have referred to them many times. They are well known in the industry, but evidently not to Pahle, else he would not continually misstate them, unless he desires to do so deliberately.

To correct only the misstatements Electrical World made: (1) Our latest average residential rate is 9¼ mills—not 7 mills per kwhr. (2) Our latest annual advertising expense (we use FPC accounting) was $1.39 per meter—not $6. (3) Our rates are subject

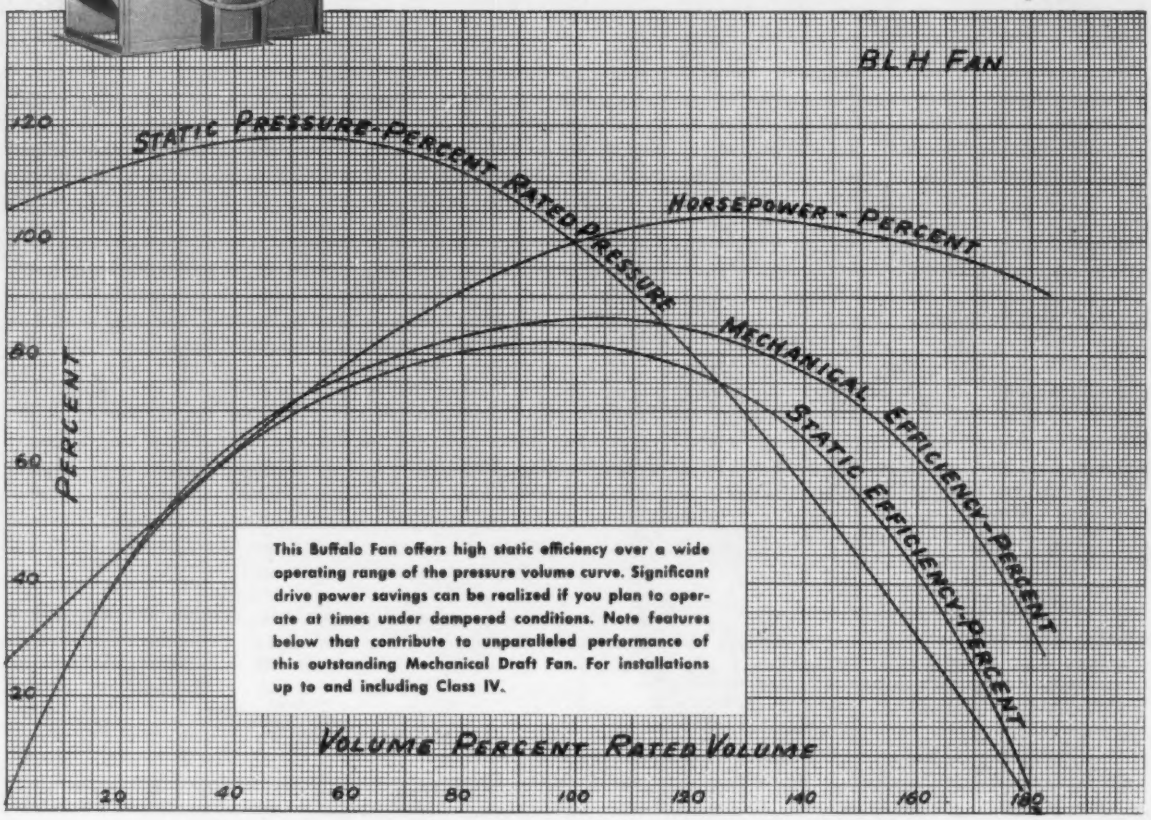
(*Continued on page* 119)



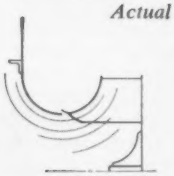
MAXIMUM EFFICIENCY

OVER BROAD OPERATING RANGE

THAT'S THE BUFFALO "BLH"

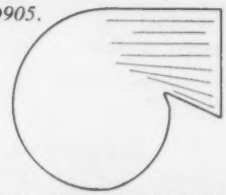


Actual performance curve of Type "BLH" Fan. Write for Bulletin FD905.



EFFICIENCY AT INLET. Cross-section of inlet shows smooth passage into wheel formed by curved inlet bell and mating wheel flange. No flat spots to cause turbulence. Fixed or variable inlet vanes available (without reducing efficiency).

EFFICIENCY IN THE WHEEL. Showing deep, **backward curve** of blades in "BLH" wheel for smooth, quiet handling of air spun into the wheel in the direction of rotation. No waste turbulence.



EFFICIENCY THRU THE HOUSING. Not only is the "BLH" housing streamlined throughout, but its unique divergent outlet delivers air to duct with easy, gradual enlargement for best distribution and static conversion.

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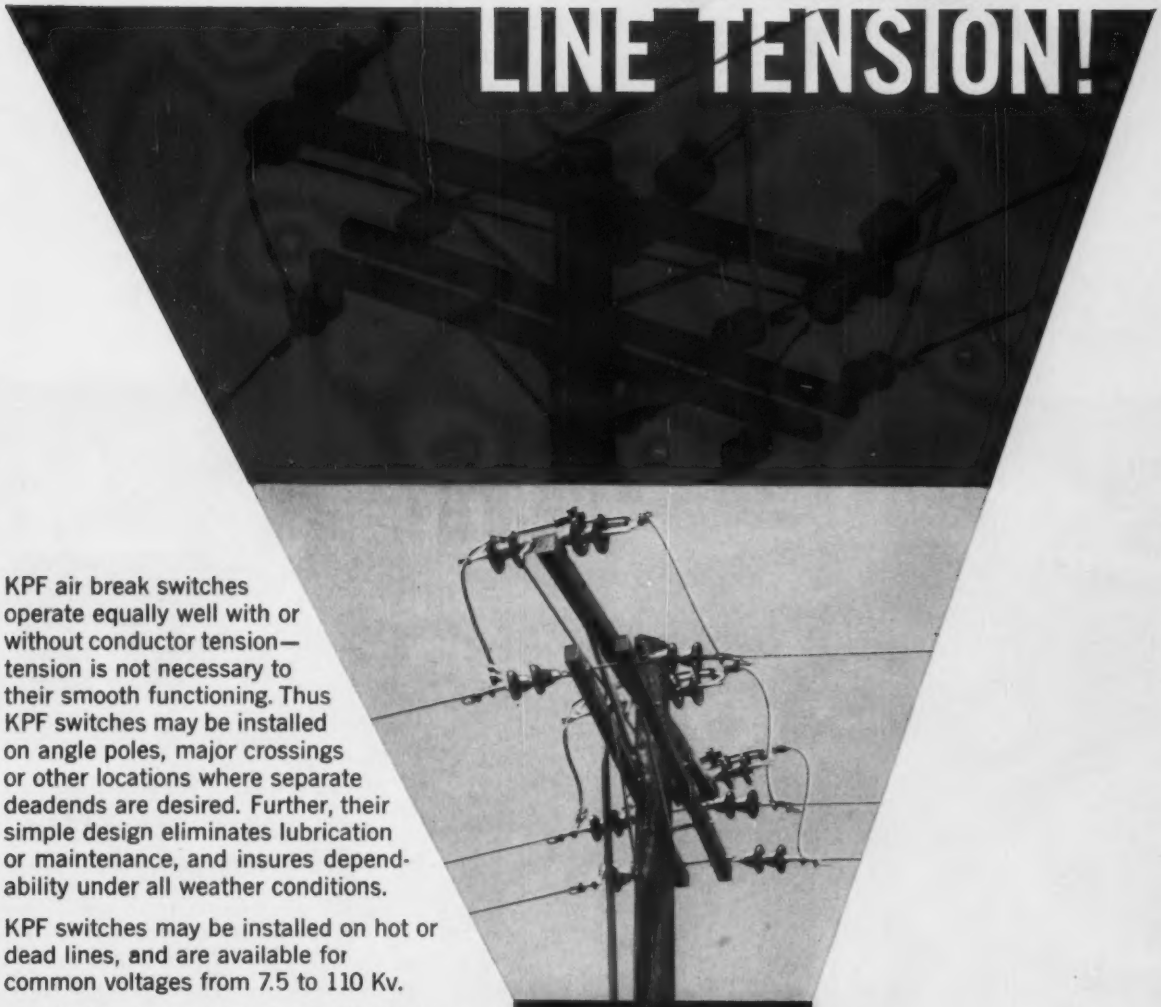

KPF air break switches operate equally well with or without conductor tension—tension is not necessary to their smooth functioning. Thus KPF switches may be installed on angle poles, major crossings or other locations where separate deadends are desired. Further, their simple design eliminates lubrication or maintenance, and insures dependability under all weather conditions.

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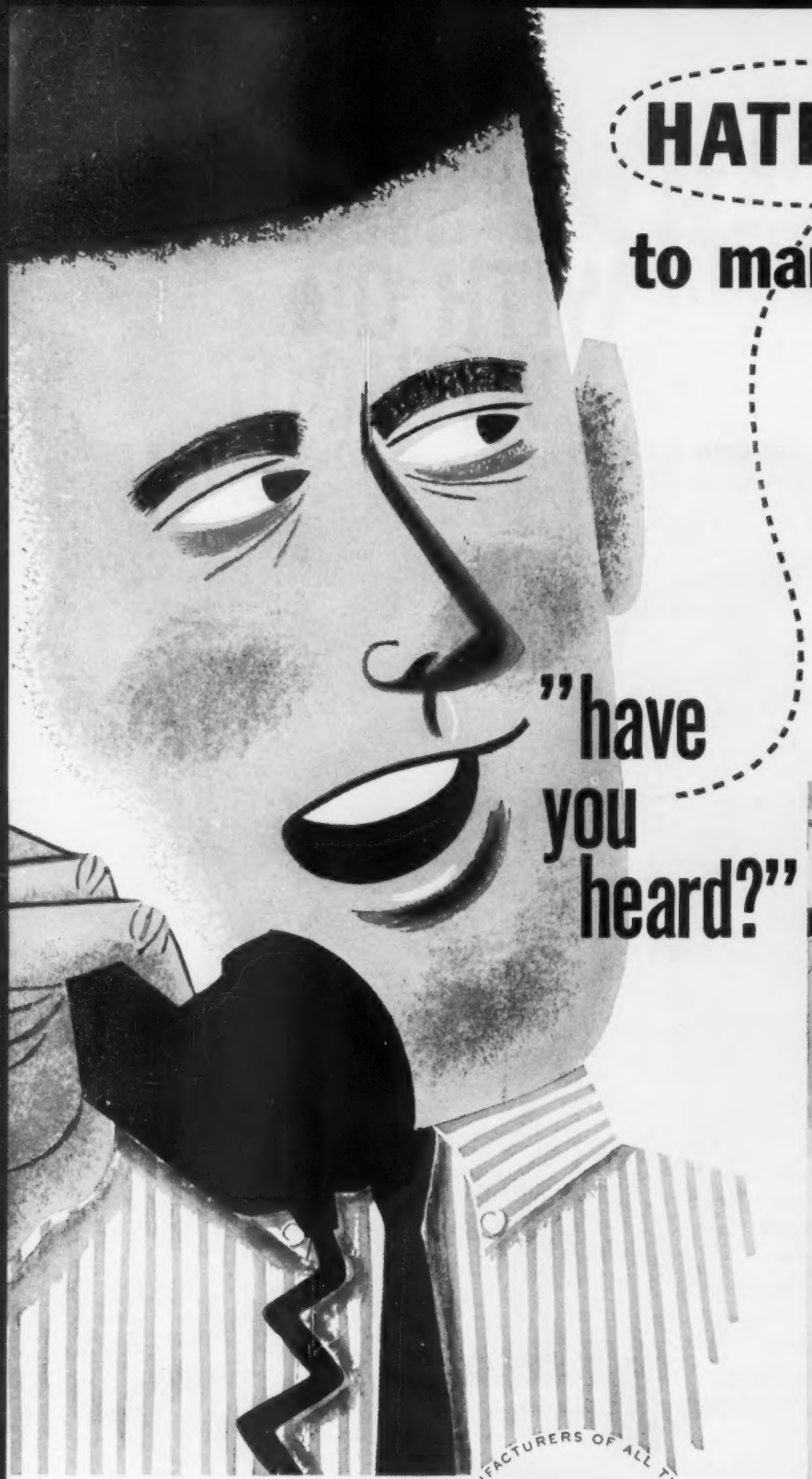
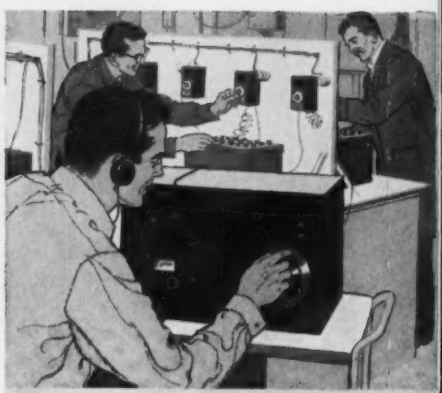


"have you heard?"



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at the new Linden plant are among the most outstanding in the high voltage cable field. In addition to the usually required quality-control test procedures for every foot of cable produced, there are also special tests. For example, we have installed a group of specially designed corona level instruments and test cables — right on the production line. Another "extra" from Hatfield to assure complete customer satisfaction.

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Here's solid proof of Hatfield's confidence in the future of the electrical industry! An entirely new plant, ready to take your orders for rubber insulated high voltage and the larger multi-conductor power cables. We're geared to produce "specials" or to ship standard items from warehouse stock as complete as you'll find anywhere. This new Linden, N. J. plant augments completely separate facilities in Hillside and Union, N. J. where most other types of wire and cable products are manufactured. It all adds up to this—whether your wire and cable needs are for building construction, light or heavy industry, governmental agencies or utilities—now you will find Hatfield to be one of the best equipped producers of the highest quality products.

This new plant for the production of rubber insulated wire and cable, together with the copper rod mill now under construction, will be part of the HATFIELD Linden complex. It is geared to give HATFIELD the most up-to-date, integrated facilities in the wire and cable field.

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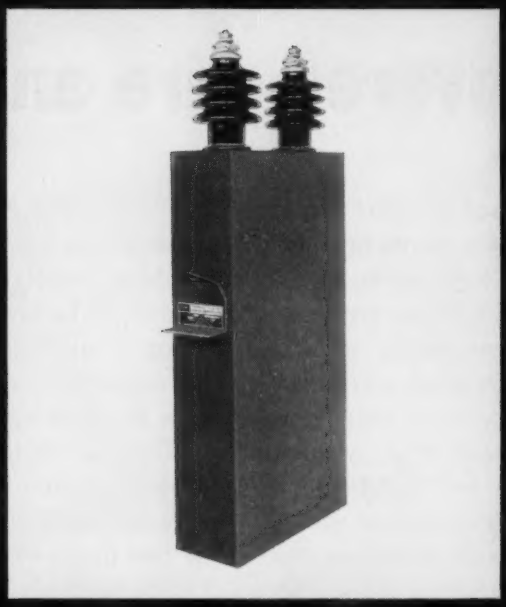

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The Electrical Week

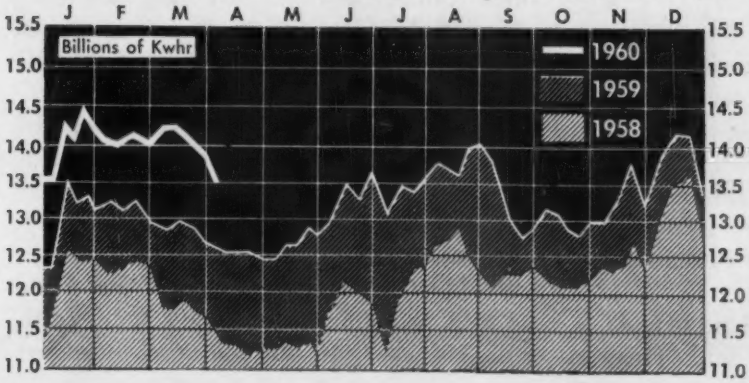
LATE NEWS ▶ **Soviet Union has completed design for 800-kv** 310-mile transmission line connecting Stalingrad with Donez River area . . . EEI will fly the banner of "Flameless Electricity" in the 1961 Live Better Electrically campaign. At the EEI Sales conference in Chicago, G. C. Rawls, president, Louisiana Power & Light, and Allen S. King, said automation is big factor in both load growth and utility problems.

Washington Wire . . . In the ear-to-the-ground department, reports are that the Administration is under pressure to dump FPC Commissioner William R. Connole when his reappointment comes due June 22. One report is that he is under attack by natural gas producers. The name of Harold I. Baynton, Democrat and chief counsel to the Senate Interstate and Foreign Commerce Committee, crops up as a possible replacement . . . Sacramento Municipal Utility District has made FPC application to build $46-million, 150-Mw Slab Creek dam and White Rock power plant on South Fork of American River in California . . . Aluminum Co of America is facing a Justice Dept charge of violation of the Clayton Act's anti-merger provisions. At issue is acquisition of Rome Cable Corp last year. The charge, familiar now, is that the merger tends to lessen competition and tends to create a monopoly in production and sale of various wire and cable products and conduit and cable accessories. Alcoa is confident that its position will be sustained by the courts because of legal investigation prior to the acquisition of Rome Cable.

Correction . . . Appalachian Power Co and IBEW settled for a 4% wage increase—not 4½% reported here last week . . . Puget Sound Power & Light Co reached same agreement, as have other companies.

Management changes . . . Thomas W. Trice, and Thomas B. Marburger are new vice presidents of Baltimore Gas & Electric Co.

WEEKLY POWER OUTPUT—Up 7.3% (Week ending Apr. 2), Kwhr 13,542,000,000



Per Cent Change From Previous Year

	Mar. 19	Mar. 26	Apr. 2
Total U. S.	+ 9.4	+ 9.8	+ 7.3
New Eng.	+ 7.2	+ 8.1	+ 6.9
Mid. Atlan.	+ 9.1	+10.3	+ 7.7
Cent. Ind.	+ 7.9	+10.1	+ 7.3
West Cent.	+ 8.0	+ 8.7	+ 2.7
Southeast	+12.3	+12.7	+ 5.9
South Cent.	+ 9.5	+ 6.4	+ 7.6
Rocky Mount.	+10.1	+ 6.0	+ 7.7
Pacific			
NW	+ 9.6	+ 4.2	+ 7.9
SW	+ 8.1	+10.8	+ 8.8

Seasonally Adjusted Index 270.6

Week Ago 276.5 Year Ago 250.9

Source: Edison Electric Institute

Preview of This Issue

EVENTS ▶ **Washington spotlight turns on Federal Power Commission** as House Interstate and Foreign Commerce Committee under Rep Oren Harris (D-Ark.) continues its probe of regulatory bodies' ethics **(p 42)** . . . In another development, FPC sets up new ground rules on hearings **(p 44)** . . . NEMA's first Electric House Heating and Symposium in Chicago draws 3,000 **(p 46)** . . . U. S. Supreme Court agrees to hear appeal in Dixon-Yates case **(p 43)**.

SPECIAL REPORT RESEARCH AND DEVELOPMENT ▶ **EW's first Special Report on Utility R&D (p 49). Highlights:**

- **Fusion power is decades away,** but solar power shows gain, and wind, tidal and geothermal techniques seem feasible **(p 50)**.
- **Conventional generation faces creeping advances;** it may gain a breakthrough from coal-burning gas turbine R&D **(p 56)**.
- **Thermoelectric, thermionic and MHD converters have promise** after 2,000-4,000F problems are solved for efficiency. Fuel cells await cheap use of hydrocarbons. All need cheap inverters **(p 53)**.
- **Transmission R&D approaches surge-proof EHV lines,** tests controls for conductor vibration and galloping **(p 58)**.
- **Distribution tries to slow tree growth,** to evaluate static relays for fast clearing, and to block substation noise **(p 62)**.
- **Digital computers speed R&D in system expansion,** generation,

Politics and Public Power

CLEARING AWAY THE POLITICAL HAZE

An attempt to clear away some of the political haze surrounding the proposed transmission tie between Bonneville Power Administration and Pacific Gas & Electric Co was made in Washington recently. At this writing, however, there's no indication of how successful it will be.

In a letter dated March 29 to Sen James Murray, chairman of the Senate Interior Committee, Assistant Secretary of the Interior Fred G. Aandahl has asked for the committee's position in the tie. If it were built, the interconnection would make possible the annual sale of $1.8 million worth of secondary BPA energy. This energy is now being wasted for lack of a market.

In his letter Aandahl said, "It is hard to find a reason for not having made the sale. This energy is now being wasted to the ocean in water spilled from federal reservoirs without generating power because there is no immediate market for such power."

"This loss of revenue is seriously jeopardizing the continuance of our low power rates in the Pacific Northwest," he added.

Aandahl also pointed out that the tie with PG&E—over a privately built, single 230-kv line—" can be made on a temporary basis without any federal transmission line construction and without any implication of a future obligation of any kind."

The Assistant Secretary reminded the committee that it had asked for a delay in the proposed PG&E line until a study could be made of high-voltage line (presumably federally-built, owned and operated) between Bonneville and California. That study was made by BPA and submitted to the committee in mid-February. It showed the proposed

planning and peaking. Weather is put into schedules **(p 64)**.

• **Heating, cooling, lighting and medicine will benefit** from electrical R&D. Flash operator advances area development **(p 66)**.

PROCUREMENT & PRODUCTS ▶ **New booklet outlines "systematic purchasing concept" (p 72)** . . . Westinghouse announces 12% higher ratings for all self-cooled, oil-immersed transformers . . . GE announces 12% hike for self-cooled distribution and medium power transformers **(p 76)** . . . Reel-carrying dolly takes reels up to 46 in. wide and 84 in. dia up to five tons . . . Drawout interruptor is designed for 14.4-kv **(p 86)**.

MANAGEMENT ▶ **Electric utilities will be using 40% more fossil fuel by 1965,** according to a survey by Keystone Coal Buyer's Guide, a McGraw-Hill publication. Although growth swing favors gas (9% compared to coal's 7% a year), coal will hold its present edge of 66.6% of industry's boiler fuel. Oil's share to be hammered down by coal and gas **(p 105)**.

SELLING ▶ **Nashville, Tenn., may be "America's Best Lighted City."** It got that way through an extensive five-year street lighting program **(p 111)**.

NEXT WEEK ▶ **Be sure to read the eight-page Commercial Cooking Special Report.**

heavier line to be economically unfeasible; to date the committee has not acted on it.

"This is a matter upon which we must have an indication of your committee's position prior to the adjournment of Congress," Aandahl told Murray.

Aandahl's letter is in conflict with one written to Murray by California's Gov Edmund G. Brown. Brown asked for a delay in Senate action until completion of a study being made for the State of California. "The study is now well under way and will be completed, with the cooperation of the states of Oregon and Washington," Brown wrote.

Brown believes that an extra-high-voltage intertie will be better than the 230-kv PG&E line in terms of over-all power developments planned or under construction in California. "Based upon initial considerations, I am convinced that this study will show the advisability and feasibility of constructing an extra high voltage common carrier intertie with adequate capacity to move large amounts of power throughout the entire Pacific Coast when available," he said.

However, the California study, being done by H. Zinder & Associates, will have only a preliminary draft of the proposed line's broader phases and conclusions by the latter part of June.

Because the Democratic National Convention is set for July 11, in Los Angeles, Congress will probably adjourn sometime during the week of July 3, which leaves little time for consideration of the California proposal, whatever it might be.

In any case, it will be worth watching to see how Sen Murray resolves the matter, whether he allows the haze to remain, or clears it away with a letter of his own.

Executive Reader

Acquisition of land in urban areas for utility plant requires consideration of these factors: A definite and logical plan for future development can contribute to court approval of acquisitions many years in advance of construction; in urban areas, there is no difference between the cost of a fee and cost of an easement; cost of land in partially developed areas may be more than offset by reductions in circuit lengths and elimination of heavy angles; substantial amounts of money can be saved in many cases by purchasing an entire tract of land and salvaging the excess; recognition of the need for heavy lines and substations should be included in future zoning regulations drawn up for semi-urban areas not completely zoned. **Right of Way Acquisition in Urban Areas, R. L. Bortner, before the Southeastern Electric Exchange, New Orleans, April 8, 1960.**

Problems of executive decision-making drawn from real life are the basis for an account of how the president of an electric manufacturing company, through an exchange of memos with his new assistant, comes to clear-cut decisions on three developments: The installation of an electronic data processing system; a merger proposal from another company; and the promotion of the company's research chief to vice president of market research. The story is fictional but the questions the president asks before making up his mind are educational. **How An Executive Makes Up His Mind, Perrin Stryker, Fortune, April, 1960.**

New light is thrown on the questions of how much a utility should spend for advertising, personal selling and publicity, and what yardsticks or operating ratios may be used as guides. A search through available statistics turned up a provocative discussion for top management, as well as for public relations, advertising and sales promotion personnel. **Sales Promotion Yardsticks for Electric and Gas Utilities, William T. Kelley, Public Utilities Fortnightly, March 17, 1960.**

The Russians are not outstripping the United States in the realm of nuclear power. Their situation is very much like our own. They have extensive fossil fuel reserves, which they can use abundantly in their thermal stations. They realize that economic nuclear power is yet to be achieved. In the overall, the Soviet power industry is now in a general state of development equivalent to ours some 25 years ago. **An American Engineer in Russia, Walker L. Cisler, before the American Power Conference, March 29, 1960.**

Experience with centrally operated generating stations over a 12-year period has been most satisfactory. Cost savings have been achieved along with the many operating advantages of centralized control. As labor costs increase, this method of operation should attract increasing attention from management of electrical systems. **Economics of Centralized Control, G. F. Green and T. D. Stanley, Electrical West, March, 1960.**

No fumbling with loose parts

The O-B 88500 Universal clamp has no loose nuts, bolts, washers, or keeper piece for the lineman to worry about. The reason, of course, is that there is no need to remove these parts in the first place.

A special spring clip holds the clamp open while the lineman uses both hands to form and bend the conductor. Then the nuts are tightened on the U-bolts. The clamping job is completed. Installation can be done entirely from one side, with the line hot or dead.

Made of galvanized malleable iron, the 88500 takes the full range of conductors from .20 to .50 inches in diameter. The very design of these clamps give them inherent high holding strength.

It's easy to see how the O-B 88500 clamp simplifies the lineman's job and makes deadending convenient and efficient. Just the time saved in speedy installation could well help pay for the clamps. Why not try them on your next deadending job and see for yourself their many advantages?

OHIO BRASS COMPANY, MANSFIELD, OHIO

Canadian Ohio Brass Co., Ltd., Niagara Falls, Ont.

Ohio Brass

HOLAN

PORCELAIN INSULATORS • LINE HARDWARE • CAPACITORS • LIGHTNING ARRESTERS
BUSHINGS • HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES • BRONZE VALVES

10037-H

The tool chest that travels

Not since the invention of the dog muzzle has anything been as warmly welcomed by servicemen as the new 1960 Dodge Tradesman.

With good reason, too. The Tradesman is literally a workshop on wheels—a go-anywhere, do-anything shop-away-from-the-shop.

Its vertical and horizontal compartments carry most of the tools you'll need on any job—and keeps them *locked up*. Swing down the horizontal door, and you've made yourself a handy workbench.

Plenty of pick-up load space, too—with lockable sliding roof available to keep whatever you carry safe and dry.

Options? How about power steering . . . push-button transmission . . . choice of gas-squeezin' Six or powerful V-8?

Your Dodge dealer can tell you even *more* good things about it. Talk to him—find out why you can always . . .

DEPEND ON DODGE TRUCKS TO SAVE YOU MONEY IN

Here's the service truck that masters any kind of weather, any kind of terrain . . . the rugged Dodge W500 4 x 4 Power-Wagon, with special utility body.

A PRODUCT OF CHRYSLER CORPORATION

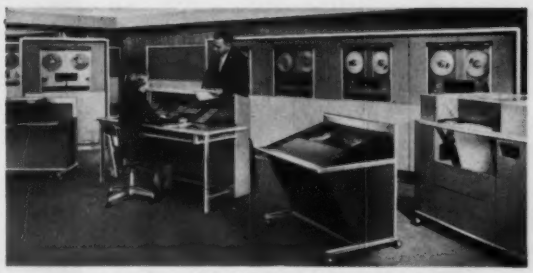
The RCA 501 fulfilled our specifications and gave us more advantages than any other comparable system we studied. The entire processing cycle, from papertape input to ready-to-mail post card size customer bills, demonstrated dramatic speed and efficiency.
BAYARD L. ENGLAND,
Chairman of the Board
Atlantic City Electric Company
ATLANTIC CITY
THE SOUTHERN NEW JERSEY SYSTEM
ELECTRIC COMPANY

RCA 501 helps achieve accounting modernization for a growing utility.

Atlantic City Electric Company serves the industrial, commercial fishing, agricultural and dairy farming counties, as well as the world renowned recreational areas, of southern New Jersey.

With the RCA 501 Electronic Data Processing System, Atlantic City Electric Company will handle a heavy flow of paperwork in one-half the time formerly required. 12,000 customer bills a day can be speedily processed by the 501—at the lowest cost per unit of work in its price class. But speed is just one of the reasons it was selected; accuracy, efficiency and easy expansibility counted heavily. Also, the all-transistor construction provides reliability and drastically reduces size and weight, as well as power and cooling requirements.

In addition to the tremendous job the RCA 501 will do for Atlantic City Electric Company, RCA Electronic Data Processing Systems are daily demonstrating power in other fields—insurance, banking, manufacturing as well as in government agencies. For full information on the advantages of RCA EDP for your business, write to—



In every engineering feature, RCA EDP Systems reflect the electronic experience and knowledge of the world leader in electronics. Arrange to see the modern Data Processing Center in Cherry Hill, near Camden, New Jersey

RCA ELECTRONIC DATA PROCESSING

RCA Tmk(s) ®

RADIO CORPORATION of AMERICA

ELECTRONIC DATA PROCESSING DIVISION • CAMDEN 2, NEW JERSEY

ALMOST HANGS ITSELF

S & C Open Cutouts take the "hit and miss" out of fuse tube handling

It's a cinch to hang the fuse tube in the Type XS open cutout. No fumbling, no missing, no dropping. Think how much easier and safer it makes the lineman's job, especially at night or during adverse weather. The operator's eye view at left shows why linemen like this cutout. There's nothing intricate about the hinge and how to approach it. Notice the wide and deep trunnion pockets in the ears of the hinge. The trunnions on the fuse tube drop in readily, without precise "steering."

Yet once the fuse tube is hung in the hinge it is positively kept from jamming or missing as it is swung closed. Multiple steering surfaces at the hinge and trunnion along with wide-angle upper contact guides give positive control. The tube can be slammed closed, blind.

Easy fuse tube installation is just one of many big advantages of S&C XS Open Cutouts. Here are more: 1) exhaust always goes down and away from operator and conductors because of single venting; 2) arc energy and exhaust violence are minimized by an "arc-shortening" device; 3) you get versatile, economical load switching with Loadbuster® (the portable loadbreak tool).

To get an idea of how the XS open cutout can give you system-wide protection and switching, please write S&C Electric Company, 4421 Ravenswood Avenue, Chicago 40, Illinois . . . and ask for Bulletin No. 511 "S&C Open Cutouts—Type XS."

S&C ELECTRIC COMPANY

S&C

NO MORE ENGINE IDLING

. . . with NEW MOTOROLA MOTRAC* 2-way radio

Idle a truck engine 4 hours a day—to regenerate for battery drain due to 2-way radio—and you waste *more than a hundred dollars* a year in gasoline alone! Add the cost of engine wear, replacement batteries, generators, etc., and you've got a significant cost leak.
But now it's *unnecessary*. Motorola MOTRAC radio uses only a trickle of current—less than a dome light—so engine idling is *out*. And that's just the *start* of MOTRAC radio savings. Truly advanced design and rugged construction give you greater *reliability*, and much longer life.
Here is truly dependable equipment for long-run economy.
It's a big story. Get all the facts about this outstanding new radio. Call or write today.

HERE'S THE INSIDE STORY—Commonest source of maintenance problems—vibrators and receiver tubes—have been replaced by dependable transistors. MOTRAC radio can be used with any 6 or 12 volt vehicle—positive or negative ground. Models available with up to 100 watts power output.

MOTOROLA 2-WAY RADIO

Motorola Communications & Electronics, Inc., 4501 A[illegible]usta Blvd., Chicago [illegible], A Subsidiary of Motorola Inc.

**MOTRAC is a trademark of Motorola Inc.*

Strong Reasons

for specifying rigid conduit in STEEL

Proved Strength

Recent comparison tests indicate that Rigid Steel Conduit is up to ten times stronger than rigid conduit made from aluminum. Steel conduit provides these strength advantages:

—300 to 1000 pct *greater resistance to impact*, depending on the magnitude of the impact and the conduit size.

—100 to 250 pct *greater beam strength* at either the full section or the threaded joint, depending on the load and the conduit size.

—150 pct *greater resistance to flattening* from static loads.

Proved Dependability

For over 50 years Rigid Steel Conduit has provided electrical circuit wiring with the most thorough mechanical protection available. *And it still does.* Inexpensive to buy, easy to install, simple to rewire, steel conduit is highly compatible with every construction material in major use.

Get the strongest protection—be sure to specify rigid conduit in steel for your next electrical job. Ask your electrical distributor for full details.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Distributor: Bethlehem Steel Export Corporation*

BETHLEHEM STEEL

BETHLEHEM STEEL

TIGHTEST MAN IN TOWN BUYS I-T-E TRANSFORMER. HERE'S WHY.

He did it to save money, of course. And he turned down a flock of other make transformers with actually lower price tags. You see, the economy of a transformer isn't all in the original price. A cheaper transformer that gives you trouble later can cost a fortune.

But I-T-E is a company that still builds transformers the way they should be built—with stronger construction, superior insulation, and lower operating losses. An I-T-E transformer can take the shock of heavy faults that can tear less expensive transformers apart. It makes less noise than the cheaper transformer. It can endure heavy loads and hot days. And it doesn't weaken even after years of use.

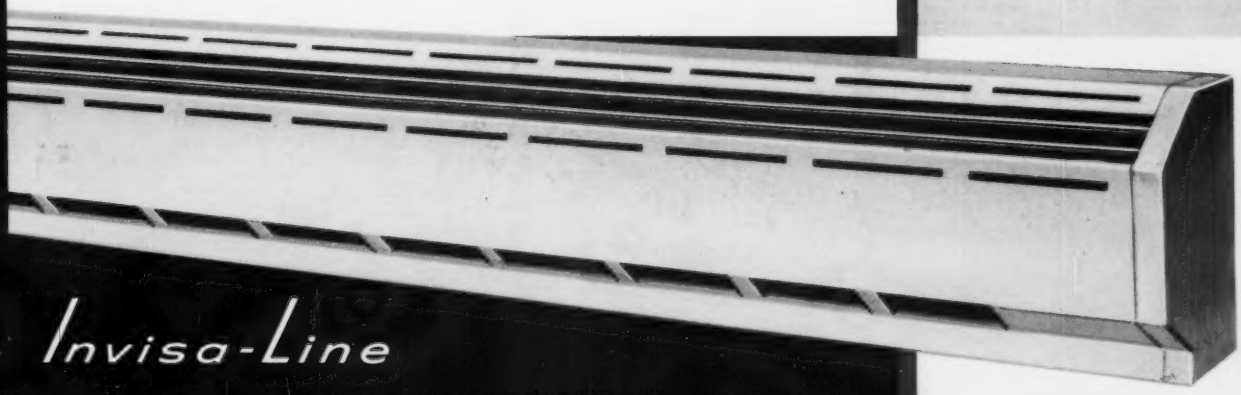
That's why so many really smart tightwads gladly pay the few extra dollars for an I-T-E transformer. They know it means greater real economy in the long run.

Write for detailed Bulletin 5804-1A. I-T-E Circuit Breaker Co., Dept. TR, 1900 Hamilton Street, Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY

brings a world of ● *warmth...*

Arvin TAKES THE LEAD IN ELECTRIC HEATING



Invisa-Line

A scant 1¼ inches thin, a sleek 4½ inches low—Arvin Invisa-Line low wattage baseboard brings you an exciting new dimension in electric heating. Here is a unit that hugs the wall and disappears from conscious view once installed. And it's yours exclusively from Arvin, world leader in portable electric heat and pioneer in electric and car heating for more than a quarter century.

Arvin not only features the pace-setting advantage of the most attractive size . . . Arvin gives you the added advantage of greater safety with Arvin's *true low wattage*—only 140 watts per lineal foot! Now you can sell these customer-convincing benefits: complete safety, more even heat distribution, no *"hot spots"* in the room. Arvin's extensive experience in providing electric heat comfort is reflected in the outstanding design and quality construction of the "heating heart" of this far-advanced unit. *A world of warmth* tells the comfort story of Arvin baseboard heat units that make the most of *all* of electric heating's advantages that insure customer satisfaction.

Electric heating is here and rapidly growing in acceptance. Team up with Arvin, foremost in styling, safety and merchandising know-how to assure yourself the biggest possible share of business from the expanding electric heating market. Compare Arvin electric baseboard with any other unit. *See* the difference in size. *Check* the safety difference in wattage. And note the tremendous selling advantages Arvin offers you with its established and accepted brand name that's nationally advertised . . . plus a hard-hitting merchandising program specifically designed to help make your Arvin electric heat sales the easiest of all in this rapidly expanding market.

the slimmest
(Only 1 3/4" Thin)

the trimmest
(Only 4 1/2" Low)

the most advanced
(Only 140 Watts per foot)

TRULY LOW WATTAGE
BASEBOARD
ELECTRIC HEAT

MILLIONS OF FAMILIES ENJOY ARVIN PRODUCTS

Arvin

All You Notice is the Warmth with ARVIN'S INVISA-LINE UNIT!

Attractively finished in the finest beige enamel, Arvin Invisa-Line baseboard heat units blend beautifully into any room of any style home. The low, slim design hugs the wall in such an inconspicuous manner, Arvin baseboard disappears from view once it is installed. The sections can be painted to match walls or baseboard if desired. Note the handsome chrome top grill that prevents objects from falling into unit and aids in directing the warm air flow outward and upward into the room.

Arvin Invisa-Line's advantages

increase the sales power of your electric heating story

Brand Acceptance—Millions of families enjoy Arvin products, advertised nationally in leading magazines. The Arvin brand name is presold and is recognized as the *leading name* in portable electric heat. These factors combined help assure ready-made acceptance for Arvin *baseboard* heat!

Research—Serving the Arvin family of finer products, manufactured in 15 Arvin plants, are the extensive Arvin research and development facilities . . . where Arvin electric baseboard heat was designed using 27 years of experience. The result—the most advanced heating systems available to builders.

Product Excellence—The exclusive design and construction of Arvin baseboard heat adds extra selling power to every advantage of electric heating:

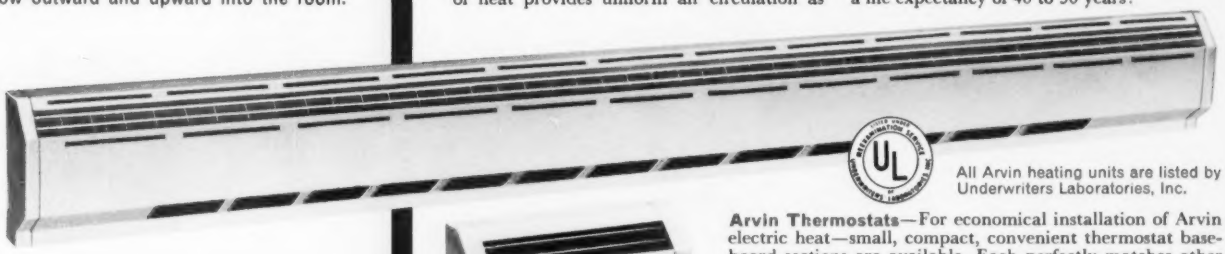
Greatest Eye-Pleasing Design and Safety—Arvin baseboard heat's unmatched trimness blends easiest into any decor, and its low wattage assures safest performance.

The Quietest, Cleanest, Fastest Heat—Arvin's heating element is mounted on floating holders to eliminate all expansion and contraction noises. The natural convection of heat provides uniform air circulation as the high-capacity heating element produces heat faster and more efficiently.

Most Accurate Heat Control—Individual thermostats provide individual room-comfort control . . . plus the unparalleled economy that results from this flexible heat control. And for absolute safety in controlling heat output, exclusive Arvin "heat-limit" safety thermostats, built into each baseboard section, prevent overheating.

Lowest Installation Cost—Arvin baseboard heat eliminates the need for expensive central heating plant installation, saves approximately 15 square feet of floor space at $10 to $15 per foot, plus a chimney at $80-$100, and all ductwork. What's more, Arvin baseboard heat sections are *pre-wired* for connection at either end saving you the time and labor costs of wiring-in.

Greater Home Value—A home electrically heated with Arvin baseboard units is a better built home. It's better insulated, better equipped with the most advanced and efficient of all electric baseboard systems, and it represents greater loan potential. Remember, too, a warm air furnace requires replacement or major repair every 10 years, whereas electric heat units, with no moving parts, have a life expectancy of 40 to 50 years!



All Arvin heating units are listed by Underwriters Laboratories, Inc.

ARVIN PRE-SELLS FOR YOU!

Across America, in leading magazines and local newspapers, powerful and colorful advertising is bringing the Arvin story of performance and quality to millions. Arvin Electric Heat is promoted as a member of the Arvin family of finer products in customer-convincing ads that mean more and easier sales for you!

Three Knockouts at Both Ends Simplify Wiring

Arvin Thermostats—For economical installation of Arvin electric heat—small, compact, convenient thermostat baseboard sections are available. Each perfectly matches other sections to provide a neat, inconspicuous installation. Arvin baseboard thermostat sections save the cost of "wiring in" a wall thermostat. Arvin wall thermostats can be used if desired. In addition to baseboard thermostat sections, one or more Arvin "*heat-limit*" safety thermostats are pre-wired into each regular section, depending on length. This safety feature, pioneered by Arvin, makes the safest heat even safer!

Arvin Heavy-Duty Fins—Faster, more efficient heat transfer—from heating element, to fins to room—is assured by advanced Arvin engineering. The extra heavy continuous fins are an integral part of the thick metal section that is welded to the entire length of heating element. To assure long, trouble-free life, heating element temperature is held to one-third of rated capacity. Heavy-duty heating element is fully guaranteed for five years, can be expected to last indefinitely!

Arvin Designs For Best Air Flow—The efficient air flow through Arvin baseboard units is indicated by arrows. Cool air enters bottom of unit, passes over radiating fins where it is warmed and is then radiated outward and convected upward. Secondary air passage in rear of unit keeps back cooler and side air circulation. New chrome baffle attaches to front of fin section, reflecting heat into air passage to further increase warm air circulation efficiency.

High Wattage Baseboard—2″ wide, 6″ high. Approximately 300 watts per linear foot. 2150 to 7270 BTU output and 2867 to 9693 BTU output.

No Other Baseboard Heat Offers the Over-All Trimness of ARVIN INVISA-LINE, plus True Low Wattage for Maximum Safety!

Arvin Electric Radiant Cable Heat

The finest in concealed heat. New! No braid or loom required; cold leads have heavy, UF-type insulation. Easily installed with new-design staples. Nickel-chrome elements.

Arvin Wall Thermostats

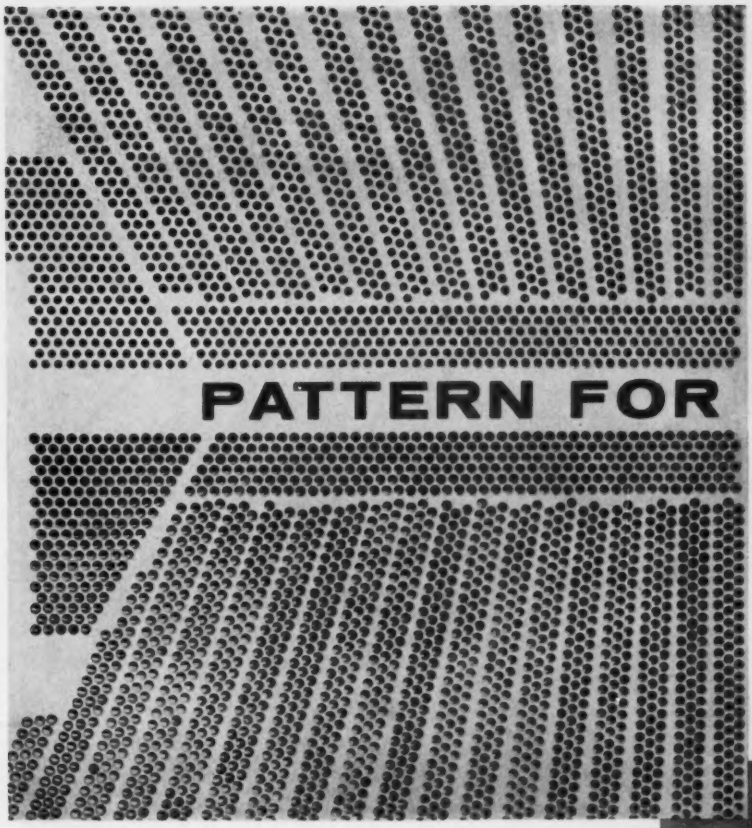
Single and double pole models. Fast reaction, dependable operation. Element reacts to *both* room air temperature and radiant heat. Flush-mounting; wires from front.

Arvin Built-In Wall Heaters

A *complete* line—six fan-forced radiant models, from 3413 to 13,652 BTU capacities. Instant-heating elements. Each model features new-design rough-in box, quick-fastening clamps, reducing installation time and costs.

Arvin
Electric Heat Division

ARVIN INDUSTRIES, INC.
Columbus, Indiana



POWER

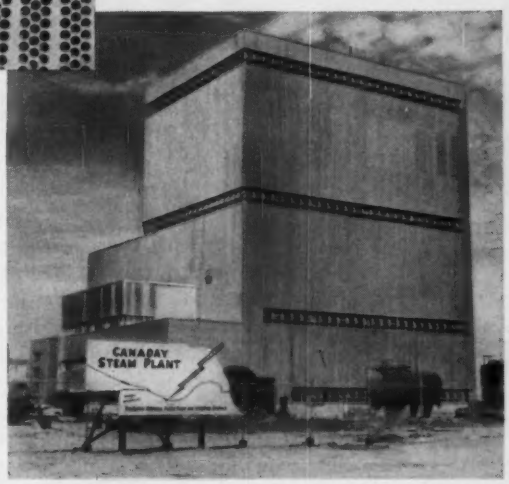
Revere Muntz Metal Plates are combined with Revere Copper Condenser Tubes to produce reliable power for new Canaday Steam Plant, Lexington, Neb.

This new 100,000 kw. plant owned and operated by The Central Nebraska Public Power & Irrigation District, Hastings, Neb., depends on a Foster Wheeler condenser for its source of power.

Revere Arsenical Copper Condenser Tubes and Revere Muntz Metal Plates were selected by Foster Wheeler to fit the specific operating conditions that will be encountered in this particular operation. Other operating conditions require other alloys.

It is this careful selection of the "metals to fit the job" that has built, for Revere, a reputation for dependable condenser tube and plate performance under all kinds of operating conditions.

Over the years, Revere's Research Department has compiled extensive data regarding the relative corrosion resistance of the different alloys under a wide variety of operating conditions. Why not take advantage of this storehouse of facts and consult with Revere's Technical Advisory Service before selecting the tubes and plates for your equipment?



ABOVE YOU SEE exterior of the Canaday Steam Plant which is equipped with a Foster Wheeler condenser. The 4 Revere Muntz Metal Plates used measure 7' 10" x 10' 3" x 1¼" while the Revere Arsenical Copper Tubes are 1" O.D. x 18BWG x 30'.

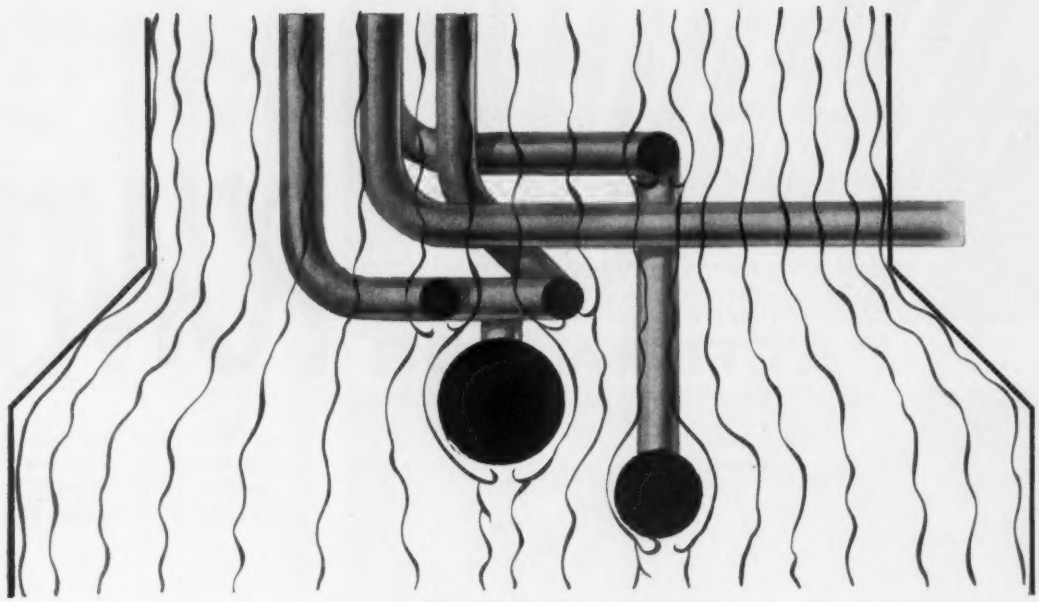
REVERE COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.

Mills: Rome, N.Y.; Baltimore, Md.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Brooklyn, N.Y.; Newport, Ark.; Ft. Calhoun, Neb. Sales Offices in Principal Cities. Distributors Everywhere.

COPPER • BRASS • REVERE • ALUMINUM

INTEGRAL FINNED TUBE • BIMETAL TUBE • INSTRUMENTATION TUBE • CONDENSER TUBES IN CUPRO-NICKEL, ALUMINUM BRASS, ADMIRALTY, HERCULOY, ARSENICAL COPPER, MUNTZ METAL AND OTHER ALLOYS; ALUMINUM TUBE, SHEET AND EXTRUSIONS; SMALL AND LARGE PLATES IN CUPRO-NICKEL, COPPER, HERCULOY, MUNTZ METAL, NAVAL BRASS AND ADMIRALTY



How to win an obstacle race

This drawing represents steam flow through the connecting piece of a surface condenser. To get from the turbine exhaust to the condensing surface, the steam has to run a veritable obstacle race—passing over and around a complex maze of heaters and extraction piping.

Proper location of these elements is a vital consideration of condenser design. If the "obstacle course" is laid out for minimum impedance to steam flow, you may save as much as .01″ or .02″ of back pressure, which means a great deal in terms of reduced plant operating cost.

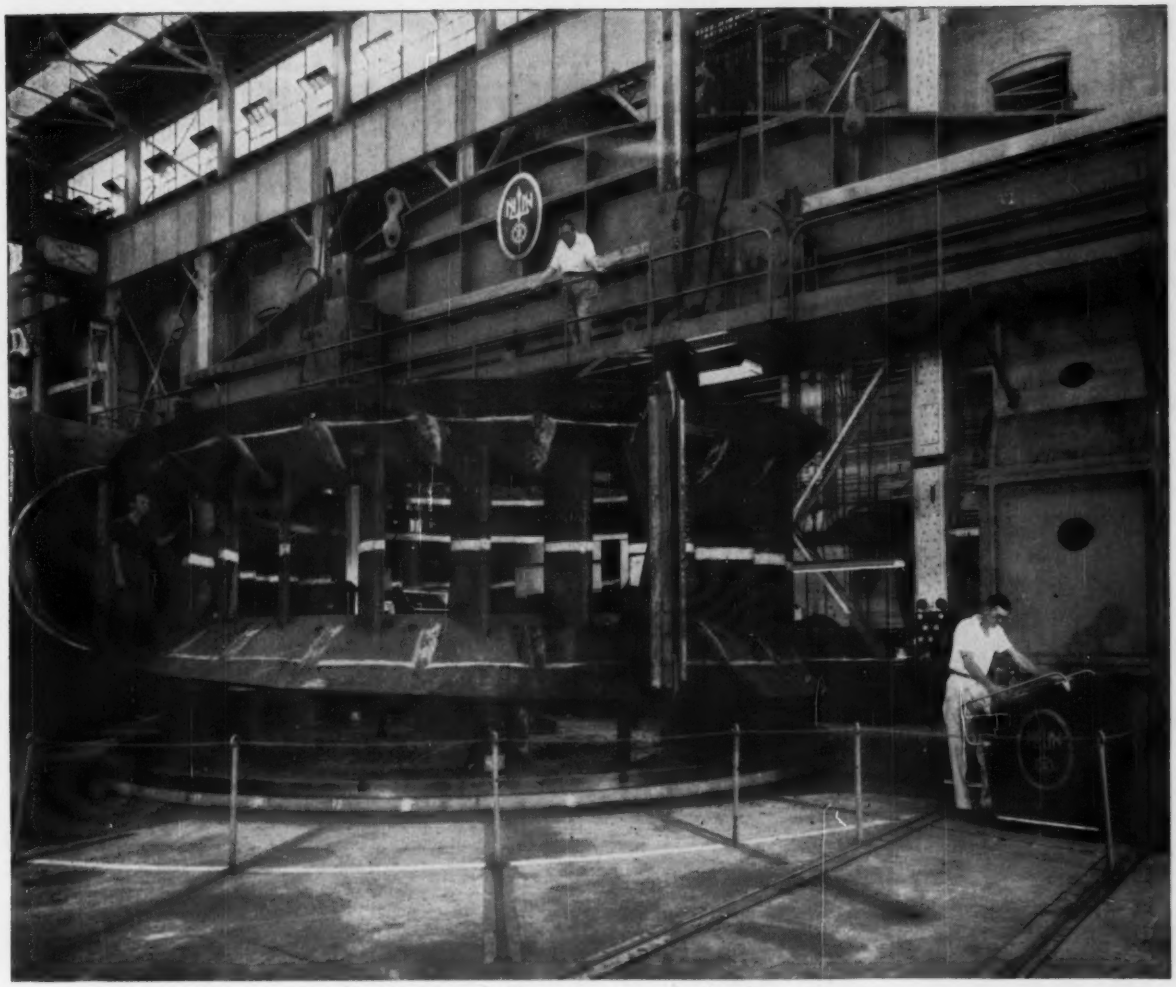
To take the guesswork out of the steam dome obstacle race, Ingersoll-Rand has recently completed construction of a new air test facility. Especially designed to permit study and measurement of fluid flow and turbulence problems, this facility enables I-R engineers to determine, with greater accuracy than ever before, the best overall heater arrangement and steam dome geometry for *lowest possible back pressure* at the turbine exhaust.

If you need a condenser — regardless of size or capacity — you can benefit from Ingersoll-Rand's *experience* and *imagination in design*, backed by modern engineering and research facilities like the new air test facility and electric computer performance optimization. Ask your Ingersoll-Rand engineer for complete information.

Ingersoll-Rand

4-993 11 Broadway, New York 4, N. Y.

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS



42 ft. boring mill-rough cuts a stay ring for one of the world's most powerful hydraulic turbines.

Newport News builds six king-size turbines for Niagara Power Project

These skilled Newport News machinists are milling a stay ring for one of six 200,000 hp. Francis-type hydraulic turbines. Before they're finished, they'll turn out five more turbines—the world's most powerful—for the Lewiston Power Plant of the Niagara Project.

Newport News has not only the men, but the facilities to take a job like this in its stride . . . your job, too. For example, the 42 ft. boring mill pictured above was designed and built at Newport News.

The large engineering and technical staffs, acres of iron, brass and steel foundries, five huge machine shops, and additional specialized equipment make Newport News a leader in the production of hydraulic turbines, valves, gates, penstocks, and other water power equipment you need.

Consult Newport News engineers on preliminary design recommendations at no obligation.

Engineers . . . Desirable positions available at Newport News for Designers and Engineers in many categories. Address inquiries to Employment Manager.

Newport News
Shipbuilding and Dry Dock Company
Newport News, Virginia

WIN A HAWAIIAN HOLIDAY

in the **HOTPOINT**
MEDALLION HOME PROGRAM

MEDALLION HOME ®
LIVE BETTER ELECTRICALLY

A fun-filled trip to America's Paradise in the Pacific awaits power supplier representatives in the Hotpoint Medallion Home Program. This dynamic advertising and merchandising program is power-packed to help you turn more builders into Medallion Home builders.

Hotpoint backs up this tremendous load-building program with the quality appliances the public prefers plus . . . . 1960's greatest boost to all-electric living . . .

NEW
HOTPOINT ELECTRIC BASEBOARD HEATING
WITH CALROD® HEATING UNITS

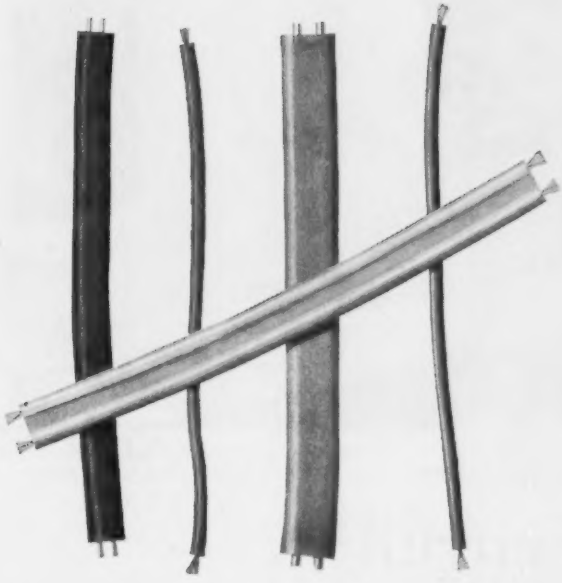
Hotpoint offers the load-building benefits of electric heating – clean, safe, comfortable, convenient, economical – plus the proven performance of famous Calrod heating units. Call your Hotpoint distributor today for complete details on new Electric Baseboard Heating, the Hotpoint Medallion Home Program, and your Hawaiian Holiday.

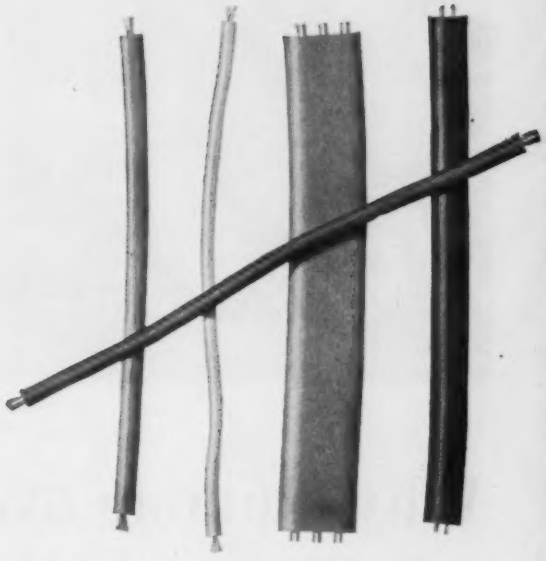
Hotpoint

A Division of General Electric Company, Chicago 44, Illinois

ELECTRIC RANGES • REFRIGERATORS • AUTOMATIC WASHERS • CLOTHES DRYERS • CUSTOMLINE® • DISHWASHERS
DISPOSALLS® • WATER HEATERS • FOOD FREEZERS • AIR CONDITIONERS • ELECTRIC BASEBOARD HEATING

One for...





OPALON® 1038 vinyl compound meets 15 insulating and jacketing specifications*

Monsanto Opalon 1038 fills so many applications, it can streamline your inventory. It combines excellent extrudability, high insulating qualities, great heat resistance and toughness even after long use under rigorous conditions. If you need to meet any of the specifications listed below, write for 1038 data to Monsanto Chemical Company, Plastics Division, Room 752, Springfield 2, Mass.

Monsanto

MONSANTO DEVELOPER IN **PLASTICS**

***INSULATION**

U.L. T, TW, and 60° C. oil exposure on both copper and aluminum conductors.

U.L. underground feeder and non-metallic sheathed cable (UF-NMC).

Class 11, U.L. standard for flexible cord and fixture wire insulation and jacket.

IPCEA Appendix I.

ASTM D-734.

MIL-W-76A, Types LW, MW, and HW.

U.L. 80° C. appliance wire.

***JACKET**

ASTM D-1047 (Passes -40° C. cold bend).

UF-NMC.

REA Spec. PE-14.

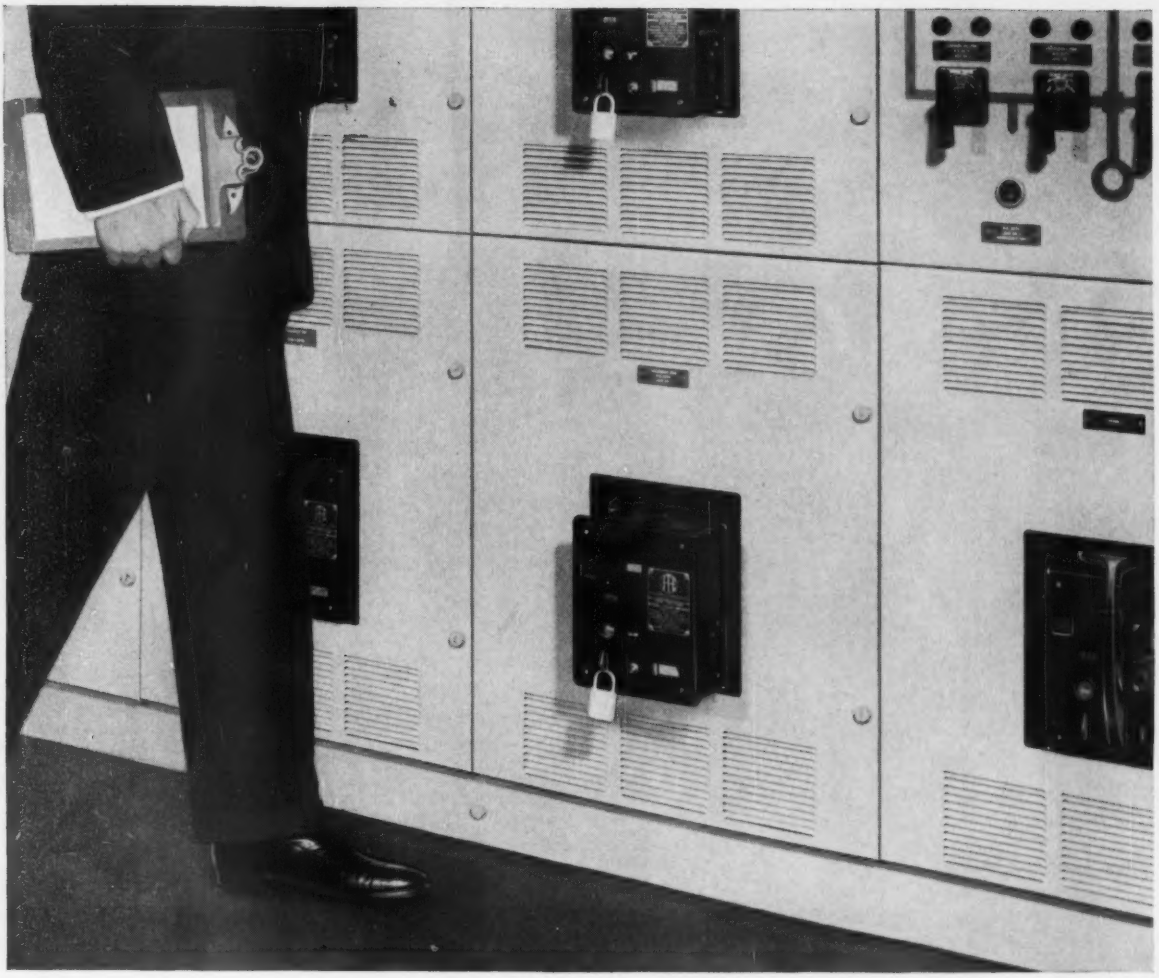
IPCEA, Appendix J.

IMSA, Spec. 19 and 20.

Inside-outside telephone cable (Staple Gun Wire).

Jan-C-17A Type I.

MIL-C-15479A (Harbor Defense).



Several of these circuit breakers are in the disconnected position. Yet the doors are safely closed. Wouldn't you like this feature in the switchgear you are going to live with for 20 years?

Why stumble over a circuit breaker door for 20 years?

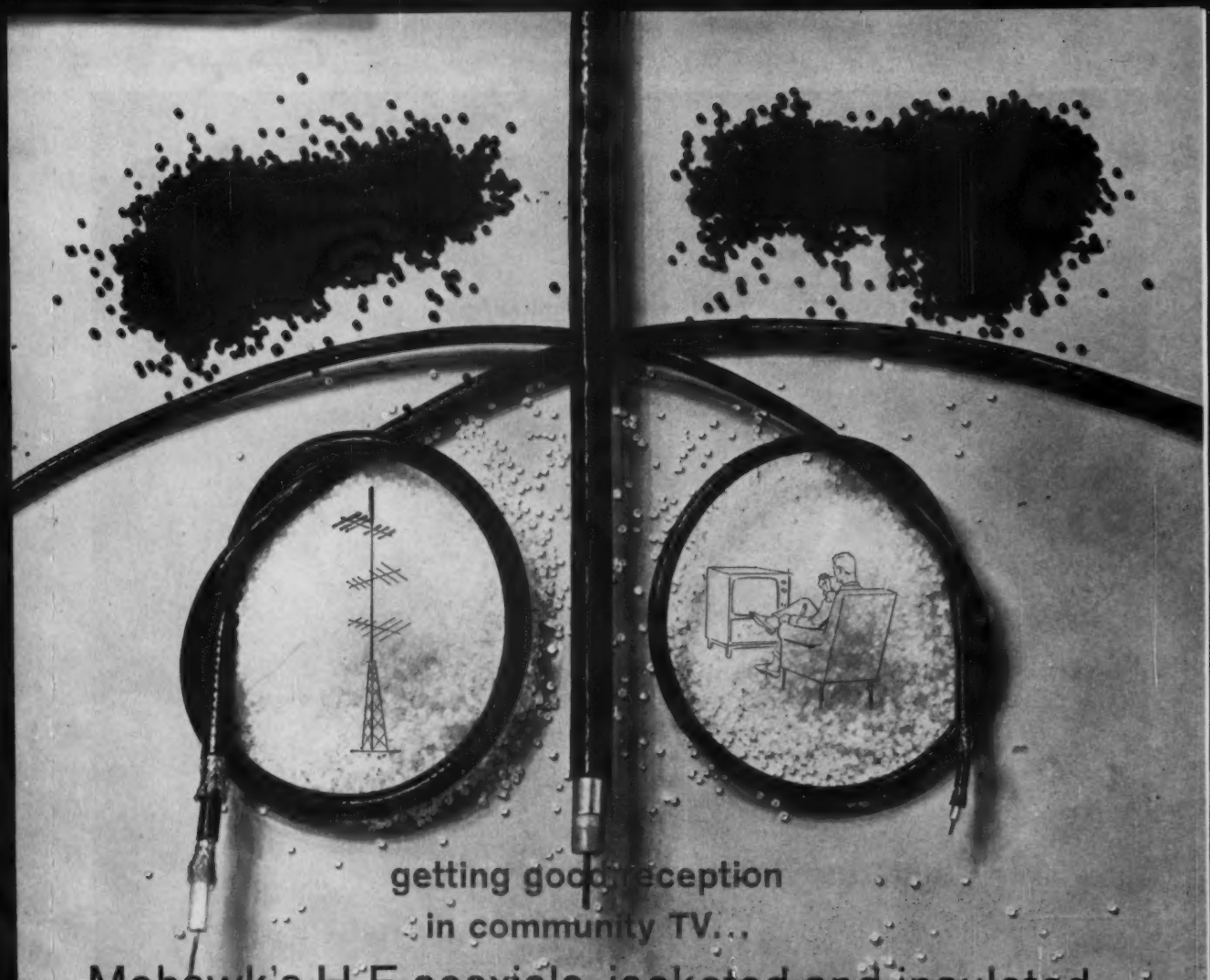
Don't let yourself be pushed around by a 600 volt switchboard. Fight back. Insist on equipment that lets you rack the breaker out to test or disconnect position without ever opening the door . . . completely safe equipment with no live parts exposed and no open doors to admit dust (see maker's name below).

Only one make of 600 volt switchgear offers this advantage (see name below). In 1957, when this line was introduced, it was the first to give you the miracle of manual stored energy closing. Today, naturally, you expect stored energy in any make of switchgear you buy.

But only this one company (see below) offers the additional advantages of completely closed door disconnect, plus expanded range trip devices that let your breakers grow with your loads. Each trip device has three to four times the range of conventional devices. Saves both cost and downtime.

The surprise is that you pay no more for this—today's most advanced 600 volt gear. Why settle for anything else? For complete descriptive Bulletin 6004-C, write I-T-E Circuit Breaker Company, Dept. SW, 1900 Hamilton St., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY



getting good reception
in community TV...

Mohawk's H-F coaxials, jacketed and insulated with TENITE POLYETHYLENE

For community television distributing systems in any area, Mohawk H-F coaxials do a complete transmission job, from tower or relay station right into the living room.

Tenite Polyethylene is used as jacketing and insulating material on these cables. It offers all-round high performance which gives them long life, keeps line loss low, and permits ease in installation.

As a jacketing material, tough Tenite Polyethylene provides excellent resistance to abrasion, weathering, moisture, and heat. Users can look forward to years of maximum protection.

As an insulating material, Tenite Polyethylene has a low power factor, which holds energy losses to a minimum. In these Mohawk cables, both solid and foamed Tenite Polyethylene are used for primary insulation... the foamed material having an even lower dielectric constant than the solid, thus making possible a thinner insulation with a resulting decrease in cable weight.

Linemen find that cable jacketed with lightweight Tenite Polyethylene is easy to handle and strip and is flexible even at sub-zero temperatures.

There is a formulation of Tenite Polyethylene to meet the demands of most insulating and jacketing applications. For further information on this useful plastic, write EASTMAN CHEMICAL PRODUCTS, INC., subsidiary of Eastman Kodak Company, KINGSPORT, TENNESSEE.

● *Both natural and black electrical grade Tenite Polyethylene are available to cable manufacturers as unique spherical pellets which flow freely in the extrusion process and in "air-veying" bulk shipments from truck to bin.*

● *Cable manufactured by Mohawk Wire & Cable Corporation, 320 River Street, Fitchburg, Massachusetts. Jacketing and insulation extruded of Tenite Polyethylene.*

TENITE®
POLYETHYLENE
an Eastman plastic

The "slave-hands" of an AI technician handle radioactive materials through a hot cell window 3½ feet thick. *Woodcut by Edward Kysar.*

Let A.I.'s experience guide your Nuclear Power Program

The largest privately-owned facility in the world for remote handling of radioactive materials is located at Atomics International's 290-acre field laboratory near Los Angeles. Here the men who pioneered the creative peacetime uses of atomic energy are applying their 14 years of experience to developing advanced nuclear reactors and associated equipment.

Much of AI's work has been on projects for the U.S. Atomic Energy Commission. This includes the Organic Moderated Reactor Experiment at the National Reactor Testing Station in Idaho and the Sodium Reactor Experiment in California. AI has also built and is operating SNAP II, a 220-pound prototype reactor designed to produce 3 KW of electricity for space vehicles.

With some of the most sophisticated facilities in the world at their disposal, the men at AI are now conducting studies for large power station reactors in the United States and Europe. Two reactors are now actually under construction under AEC programs—an Organic Moderated Reactor in Piqua, Ohio, and a Sodium Graphite Reactor in Hallam, Nebraska. Smaller research reactors have been built by Atomics International for Denmark, Germany, Italy, Japan, Puerto Rico and several sites in the U.S.A.

For details contact: ATOMICS INTERNATIONAL, Canoga Park, California, U.S.A. Cable address: ATOMICS.

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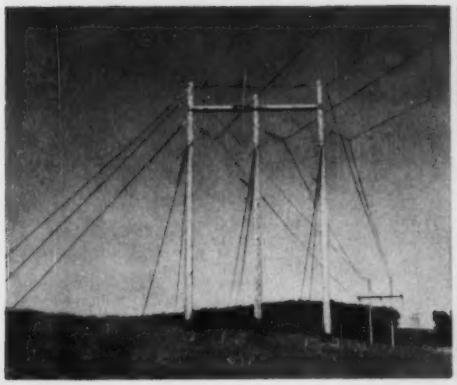

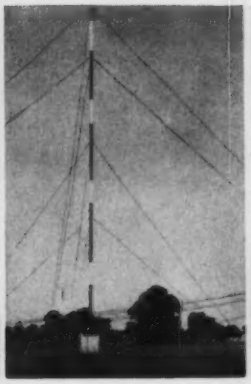

Copperweld® TYPE M™ GUY STRAND

...requires no maintenance

...matches pole life

Install Copperweld Type M Guy Strand on your lines. It's a low-cost, money-saving way to rid yourself, once and for all, of the trouble and expense that result when guys weaken or fail because they haven't got what it takes to resist corrosion.

Type M Strand resists corrosion. You can put it up and forget it. Each wire is permanently protected against rust by a thick copper sheath that is inseparably molten-welded to a high-strength alloy steel core. And because it's molten-welded, the copper will not crack, flake or peel. As a result you eliminate maintenance costs.

Moreover, Type M Strand goes up fast because it is easy to handle. It can be readily dead-ended by any of the conventional methods. Our Engineering Data Bulletin E.D. 1878 gives you the complete story. Send for it today.

COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION *Glassport, Pa.*
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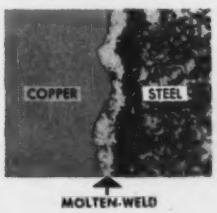
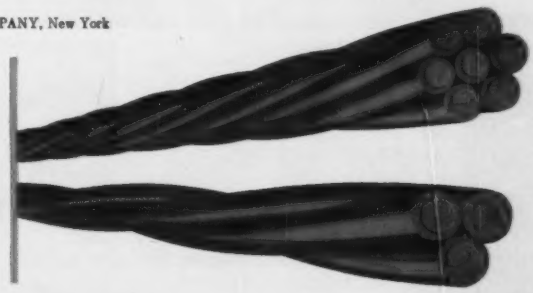




This microphotograph of the Molten-Weld shows how the grains of copper and steel interlock to form a permanent, continuous weld.

"How your purchase dollars
return to you
through Westinghouse leadership"

A. J. Maslin, *Manager, Substation and Tap Changer Engineering*

New Triplex three-phase distribution regulator costs 30% less, uses 26% less pad space, cuts weight 39%

Now you can enjoy the true economies of a low-cost, three-phase feeder voltage regulator . . . with all the *time-proved capabilities* of the Westinghouse line of distribution regulators. In fact, Westinghouse uses three well-known URF regulators, gang-operated in a single tank to bring you these big savings. The new type SVR-FT regulator is completely automatic and self-contained. Available in 8.6- and 13.2-kv voltage classes.

The savings of standardized design are passed along to you in both initial cost savings and reduced operating costs. Savings of 30% and more. Answering the need for compact units, the SVR-FT requires only 49″ x 87″ of free area for a 500-kva regulator . . . 26% savings in space. This same unit weighs just 10,700 pounds . . . 39% savings in weight.

You also gain all the advantages that have been proved in hundreds of Westinghouse URF installations: continuous monitoring with the CVR inverse time delay relay, direct drive geneva tap changer, and 1¼%-step regulation. Check the picture captions for more details.

Call your Westinghouse sales engineer to learn more about the way your purchase dollars return to you through extra values such as the SVR-FT.

J-70937

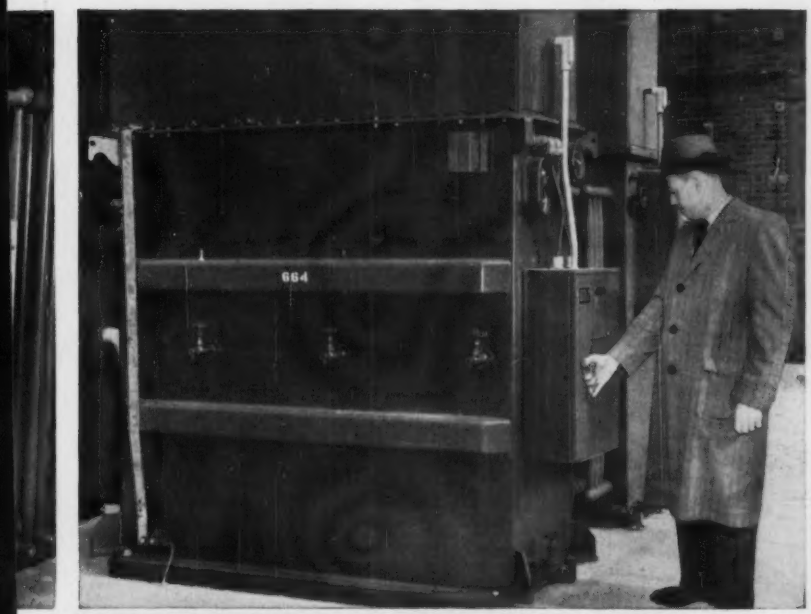
Continuous system voltage monitoring of the CVR relay provides faster correction of abrupt voltage changes . . . holds closer to set balance voltage.

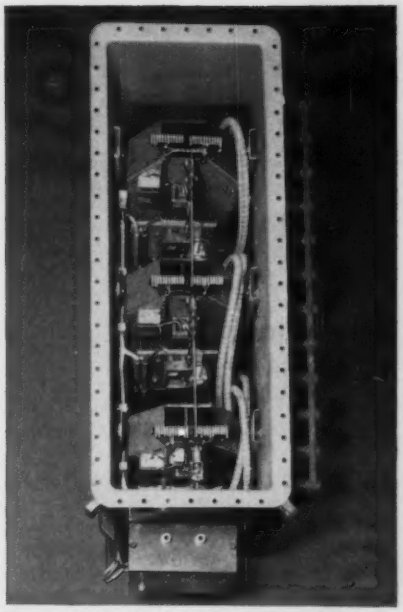
YOU CAN BE SURE...IF IT'S **Westinghouse**

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV ALTERNATE FRIDAYS

Instant-response tap changer corrects voltage 15 times faster. Requires only one second for 1¼% correction after relay operation; full buck to full boost in 13 seconds.

Mr. E. H. Carroll, Westinghouse representative, inspects the installation of this SVR-FT voltage regulator which offers a low-cost approach to three-phase regulation. Operating on the Oklahoma Gas and Electric system, the new regulator is completely self-contained.





Three single-phase units are mechanically interlocked . . . uniform tap positions assured. Units are interchangeable . . . can be removed without disturbing others. Separate tap changer compartments prevent contamination of main tank oil.

VOLTAGE REGULATOR OUTPUTS
5/8% STEP
1 1/4% STEP
UPPER BAND LIMIT
OPERATION OF 1 1/4% STEP TAP CHANGER
OPERATION OF 1 1/4% STEP TAP CHANGER
2 VOLT DEAD SPOT
BALANCE VOLTAGE
1 1/4% STEP AVERAGE ERROR
5/8% STEP AVERAGE ERROR
LOWER BAND LIMIT
OPERATIONS OF 5/8% TAP CHANGER
OPERATIONS OF 5/8% TAP CHANGER

Sixteen-step (1¼%) regulation provides narrowest *effective* bandwidth. There are 42% fewer operations than with any other three-phase regulator . . . less wear, longer life.

Government Finds Air Grows Dirtier Despite New Preventive Push

* * *

Los Angeles Leads in One Type Of Dirt, Phoenix in Another; Local Groups Confer Today

By James A. Reynolds
Staff Reporter of The Wall Street Journal

WASHINGTON—The Government is about to unveil the initial findings of the first systematic attempt to measure the scope and seriousness of a major national problem: Dirty

You can't get rid of atmospheric contamination..

The dry desert ... heavy load of nose-clogging ... it's relatively free from the chemical ... pounds which may cause lung cancer, eye smarting, bronchial ills, and other ailments. Not surprisingly, Federal air samplers found the highest concentration of these air-borne chemicals in Los Angeles, fondly called "The Smog Capital of the World" by some of its residents.

Phoenix and Los Angeles are only two of 167 spots across the country, both urban and rural, where the U.S. Public Health Service is regularly taking air samples. The first Federal findings, based on samples pulled out of the air last year, will be made public here during a Government-sponsored National Conference on Air Pollution that starts today.

The Keys and the Capital

Even the layman can see a startling difference in some of the samples tested by the P.H.S. One filter which will be exhibited this week has only a few specks on its white surface; it was used in sampling the pure ocean air in the Florida Keys. Another filter turned dirty brown during its 24-hour run; it came from the nation's capital, where the air is relatively clean—for a big city. But a third filter is caked with jet black grime; it came from Cleveland.

The sampling network, it's hoped, will provide answers to two questions which have long puzzled public health experts: Where is the air dirtiest now? Where is it getting dirtier? Last year's sampling should answer the first question, while subsequent surveys should answer the second one. Once they know the extent of the air pollution problem, officials add, they can intelligently work out an effective air-cleaning program.

"Pollution of the air is an unwanted by-product of progress, and it tends to grow as our cities and industries grow," warns U.S. Surgeon General LeRoy E. Burney. "It is time for us to take stock of what we know and what is being done about air pollution, and to outline a plan which will enable us to keep pace with the growing dimensions of the problem."

This week's conference is designed to speed up the stock-taking process. Air pollution experts from all over the country will analyze the causes and effects of dirty air, and offer proposals for cleaning it up. Dr. Burney hopes the conferees will agree on a 10-year anti-pollution plan which will include specific goals ... research programs and pollution-

Lapp introduced the "Fog-Type" insulator design 35 years ago to answer the demand for an effective means of overhead transmission under conditions of severe atmospheric contamination.

All evidence points to the fact that dirt conditions today are worse than ever before, and that there is no real relief in sight.

Realistic appraisal of the problem dictates the wisdom of ***handling*** dirt conditions, which, for outdoor distribution, transmission and station systems, means ***insulating*** for it.

. . . . . Better <u>insulate</u> for it

Why has Lapp's 35-year concept of Fog-Type design remained the one constant in this much-misunderstood area of insulator behavior? Why have Lapp Fog-Type corrugations become the industry standard design for bushings, potheads and other critical outdoor use?

It is because Lapp Fog-Type design is based on the principle of avoiding leakage flashover by controlling leakage current flow. The extra length of leakage path is also a uniform leakage path. Dry, high-resistance, shielded areas of insulator surface are avoided; instead, there's a maximum exposure of surface to contamination . . . to wetting . . . and to cleaning action of wind and rain. Current flows evenly, voltage is distributed over the surface, leakage flashover is prevented.

Even in most areas of severe atmospheric contamination, Lapp Fog-Type insulators require no cleaning; where they do, cleaning intervals are longer, and cleaning is easier than on other types.

Forward utility thinking now calls for use of Fog-Type insulation on *all* systems in sea-shore or urban locations. It pays off in improved service and reduced maintenance costs.

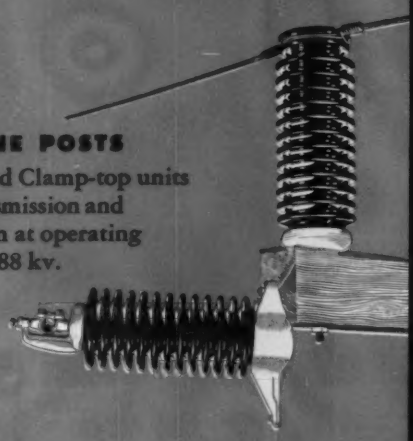
"Fog-Type design" has been a provocative subject over the years. Lapp's viewpoint is explained, and substantiated, in the new Lapp Catalog No. 8. If you have not received a copy, ask for it.

Lapp Insulator Co., Inc.,
LeRoy, New York.

Lapp

LAPP DISTRIBUTION FOG-TYPE INSULATORS

• Fog pin-types for voltages to 20 kv; Distribution Posts in three sizes for use up to 27 kv; Fog-Type distribution dead end insulators; Distribution switch Posts in four sizes to 150 BIL.



LAPP LINE POSTS

Tie-wire and Clamp-top units for subtransmission and transmission at operating voltages to 88 kv.

LAPP STATION POSTS

Superior electrical and mechanical characteristics for all switch and bus support at voltage ratings to 1,800 BIL.

SUSPENSION FOG-TYPES

Standard strength (15,000-lb.) and high-strength (25,000-lb.) units for 5¾" or 6½" spacing, either ball-socket or clevis type.

Holan heavy duty Elbow does double duty as derrick

Lifting workmen high into the air—or out—or down is only one of the uses of the Holan Elbow.

Equipped with an optional winch, the Elbow becomes one of the most versatile derricks in the field. It can be used for setting poles or lifting heavy loads and can be operated from either side of the body or the rear.

Because of 360° continuous rotation of the mast, the Holan Elbow used as a derrick can be located in any number of positions without moving the truck. This saves time — and money — in construction and maintenance work requiring derrick operation.

The winch can be installed on any of the three Holan Elbows: HD-42, HD-50 or HD-55. It will lift 4,000 pounds and set poles up to 65 feet in length.

Mounted on the mast, the winch is hydraulically driven from the Elbow hydraulic system with power from the power take-off or from a separate gasoline engine.

In the Holan Elbow you have an aerial elbow that reaches up as high as 55 feet and a serviceable, versatile derrick —*all in one.* Write us for complete details—or get in touch with your Holan Field Representative.

Holan Corporation, 4100 West 150th Street, Cleveland 35, Ohio
Plants in Cleveland, Ohio; Griffin, Georgia; Phoenix, Arizona

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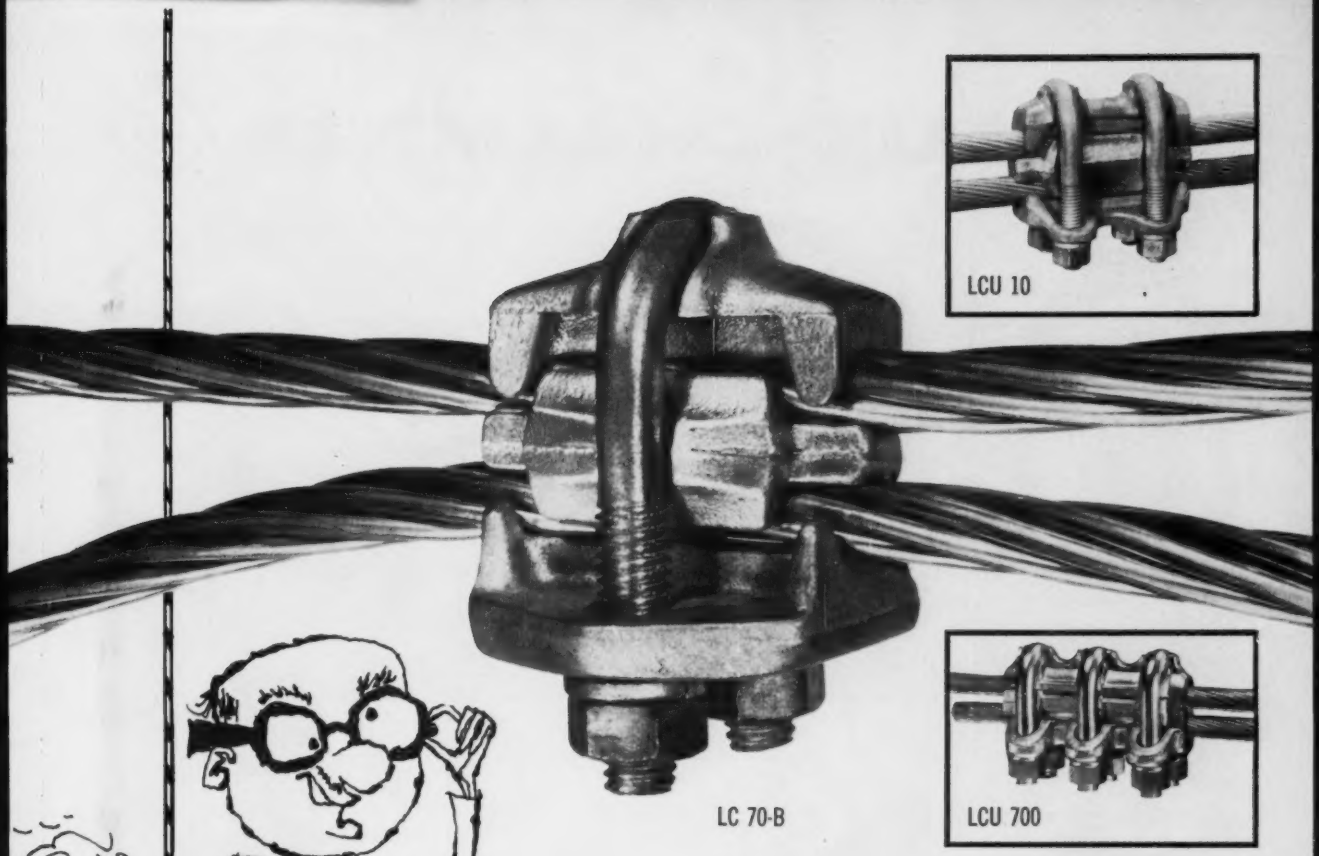

Anderson U-Bolt Connectors Give You **More Contact Area... Greater Cable Protection!**

For maximum high-current flow and cable protection, always specify Anderson U-bolt connectors.

- Wrap around design of body and high conductivity "Cover All" spacer provide full length contact, maintain cable configuration, prevent inhibitor "washout."
- Flared cable mouths eliminate cable chafing.
- Wide cable-range of each connector size helps keep inventory stocks to a minimum.
- Easily and quickly installed; ideal for many applications: loop dead-end, tap or jumper connections.
- Cast from rugged, high strength aluminum; equipped with extra sturdy clamping bolts. Also available with copper liners for aluminum to copper connections.
- Proven by over 30 years of satisfactory service.

Andy says, "No wonder Anderson has the most sought after design and performance standards in the industry."

See your Anderson representative for details or write to us direct. All inquiries answered promptly.

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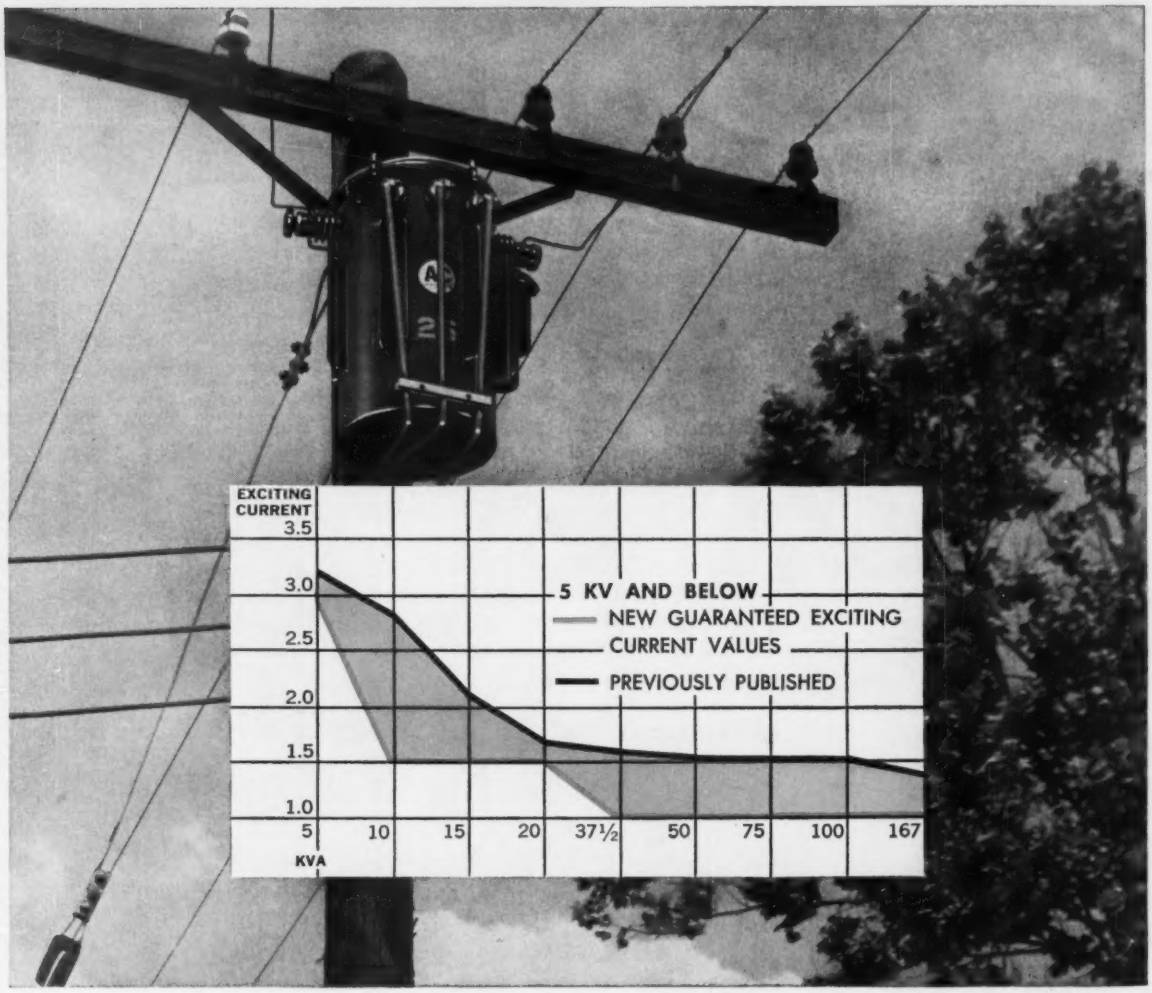


More revenue-producing power for you

with Allis-Chalmers distribution transformers

Exciting current cut as much as 50%!
No small figure whether you consider it by the unit or by the system!

It's all a matter of efficiency. And the published curves above show how much more efficiency you get with Allis-Chalmers distribution transformers.

Here's how it pays off for you. A-C units cut generating capacity requirements. Just a bare minimum of nonrevenue-producing exciting current is needed. As a result, copper loss on transmission lines is reduced. And there's less demand for system power-factor corrective equipment. Now your system carries a higher amount of revenue-producing power!

Advanced research, development, materials and facilities are the keys to Allis-Chalmers continuing improvement program.

Your nearby A-C office has all of the revenue-boosting facts. Or write ***Allis-Chalmers,*** *Power Equipment Division, Milwaukee 1, Wisconsin.*

We Must Participate to Benefit From Research

Research and development offer electric utilities a unique opportunity to obtain long-term benefits for themselves and their customers. Today a profusion of breakthroughs is foreseen in energy sources and methods for conventional generation, transmission, and other phases of design and operation. But to reap maximum benefits, utilities must get into the act.

Research and development are at an unprecedented level, spurred by the international drive for technical superiority. Deployed in the utility phase of this drive are scores of teams representing all major electrical manufacturers and an impressive number of utilities, reinforced by such other industries as chemical and aviation. The power of the attack, and the resources at its disposal, guarantee a continuing flow of innovations.

Electrical World has surveyed this drive for nearly six months. Through the cooperation of many manufacturers and some utilities, we have collected an impressive volume of information. The highlights are compressed into this issue's 20-page Special Report. But we found people asking:

1. How much of this research and development is a utility responsibility?
2. How should utilities participate?
3. How can utilities be sure that research and development will benefit them and their customers?

First, utility responsibility is clearly involved in the application phase of research. Most projects must, at some time, move from the laboratory to the prototype stage for evaluation. Resulting lore and experience are later applied to full-scale projects, but under observation resembling that of a laboratory. Active participation with manpower, money, and material, is an essential utility responsibility in this phase of the work.

Participation demands that utility engineers have first-hand knowledge of the equipment and processes they will be called upon to operate. The best way to get this is to assign these engineers to teams developing the equipment, a practice already well established in the nuclear field. Their objective should be to learn by participating in the team's project while leaving unfettered the initiative of the project sponsors, be they manufacturers or others.

Utilities will reap the optimum benefit from research and development only through continuous, close observation of its progress to determine when and how to get into the act. The best way to do this is to set up groups of well-qualified engineers to follow research and development. These groups should participate in formative phases and supervise prototypes and early commercial applications. They should also be charged with communicating research and development information to other personnel and, through proper channels, to the utilities' customers.

Some utilities have recognized the importance of research and development and set up organizations for it. The Edison Electric Institute's Research Projects Committee provides a communication channel for them. This committee, aided by over 100 correspondents in member companies, listed over 1,600 active or recently completed projects. It has also reviewed nearly 600 suggestions for future projects and found about 25% worthy of active work.

Thus the utility industry shows a growing awareness of today's research and development drives. But it needs to build up manpower in this area, solicit assistance, and speed the early application of promising innovations. Only thus can utilities take full advantage of this unique opportunity to reap long-term benefits for themselves and for their customers.

FPC Members Speak Out on Ethics

Washington's political spotlight on manners and morals of regulatory agencies has shifted to the Federal Power Commission. FPC's relations with the industries it supervises—mainly electric power—hang in the balance.

The current furor started with Congressional testimony by Commission Chairman Jerome K. Kuykendall that a gas pipeline company's lawyer—Thomas G. Corcoran—contacted three FPC members while his company's gas case was up for commission decision. Following Corcoran's contacts, the commission decided to leave open the question of a 7% rate of return for the Tennessee Gas Transmission Co pipeline project rather than approve a lower rate supported by the FPC professional staff but opposed by the company.

Rep Oren Harris (D-Ark.), chairman of the House Interstate and Foreign Commerce Committee, is leading a Congressional look at the problem of regulatory ethics. His committee is considering legislation in the area. It was before Harris' committee that Kuykendall told of the contact by the pipeline lawyer.

The Harris committee expects to recall FPC members during the course of the ethics hearings, and several committee members are expected to probe deeper into FPC's relationships with the companies it regulates.

Regulatory officials say some of the most flagrant violators of Commission rules of conduct, however, are members of Congress themselves, particularly in electric power cases. Congressmen freely contact commission members and staff officers in behalf of pet projects.

KUYKENDALL "The main thing is still the integrity of the individual commissioners . . ."

CONNOLE "In the abstract, it is wrong, but in practice it is going to be done . . ."

When Is Contact Permissible?

The controversy poses the question: When can an electric power company representative or other industry official properly contact a member of the FPC?

For the FPC itself, the answer to the propriety question seems to depend strictly upon the circumstances of the contact.

"Under some circumstances it is wrong (to have such contacts) and under other circumstances it isn't," says FPC Vice Chairman Arthur Kline.

Kline says he never willingly permits anyone to discuss pending decisions with him. On at least one occasion, he says he walked a man to the door when the visitor started talking about a pertinent case.

The power commissioners believe it is part of their job to see lawyers, industry representatives, and staff members about general problems.

When Kline has any reason to believe a person is trying to influence him, he says he is "very careful" to make sure they have not. There have been four or five instances since his appointment to the Commission in 1956 where he felt unquestionably that attempts were made to influence his judgment and decision. The commissioner confines his criticism of industry contact, however; he absolves attorneys who practice before FPC. "Practically none of the lawyers who practice here ask any special favors," he says.

Commissioner William Connole caps his analysis of the industry contact question: "It is necessary to rely on the integrity of the individual commissioner."

"I oppose and regret the necessity of some of these company men making representations about pending cases, but we have to be realistic enough to realize it is going to be done," Connole says. "They are a general pipeline for information, and they would not be here if that were not true.

Connole cites a recent instance when a group of Wall Street men met with the Commission to talk privately about general economic matters, including the bond market. "They told us what they thought we were doing wrong, and we told them a few things they didn't seem to realize about our job." The result, he said, was general enlightment for both the financiers and the commissioners.

Connole has his rule of guidance for talking to industry representatives: "It's all right to talk about generalities, but it is not all right to talk about specifics in a case."

HARRIS is looking at the over-all subject of regulatory ethics to see whether legislation is needed

ROGERS says to let the FPC rely solely on the public record in a contested case. Contacts must be put in record

KLINE "Under some circumstances it is wrong (to have such contacts) and other circumstances it isn't"

Members of FPC agree that a stringent code which would prevent all contact by commissioners with industry spokesmen might do more harm than good.

Commissioner Connole believes he would be hampered in his job if he were prevented from all contact with people doing business before FPC. Both Connole and Kline say they find it valuable for industry officials to come in and talk over their general plans for the year.

Congressional Definition Needed

"I'd like to see Congress define what we can do," Kline says. But he wants to avoid the imposition of strict courtroom-type procedures such as those which bar a lawyer from discussing a case with a judge while the court's decision is up in the air.

Kuykendall commented "The main thing is still the integrity of the individual, and the real solution doesn't lie in laws."

But there is growing dissatisfaction in Washington with revelations of influence in high places on some agencies. All are now suspect, and some type of code may be adopted.

Attorney General William Rogers has proposed rules of conduct in connection with a case. Rogers would require that a commissioner who receives any "off the record" contacts and arguments on the merits of a pending case inform his fellow commissioners and insert the arguments into the public record. Failure to do this in a proceeding of a judicial nature would disqualify any commissioner from further participation in the case, and if he did participate, make the agency's decision null and void.

For the private businessman, Rogers would have the FPC rely solely on the public record in a contested case. Any effort to contact or influence agency officials on a pending case—outside of what shows on the public record—would cost any applicant his right to win, and should close the doors of the agency to him.

The Justice Dept proposal has received no official standing, but Rogers has recommended that regulatory agencies adopt such a rule to guide their own conduct and the conduct of industry representatives. So far, however, no agency has adopted the Attorney General's rule.

Supreme Court Will Hear Appeal on Dixon-Yates

The legal remains of what once was a political football, the so-called Dixon-Yates power contract, will now be decided by the U.S. Supreme Court. The court this week agreed to take on the government's appeal from a Court of Claims ruling last year that awarded $1.8-million in damages to the Dixon-Yates private power group.

The Supreme Court action means the case will be argued and decided sometime early in the next term of court, which begins next fall. In appealing the Court of Claims ruling, Solicitor General J. Lee Rankin said the lower court had emasculated the conflict of interest law.

The issue centers on what the government now argues was a conflict-of-interest role played by Adolphe H. Wenzell, who served both as a government consultant on the early stages of contract negotiations and as an advisor to the First Boston Corp, which ultimately became sales agent for disposing of Dixon-Yates securities. The Court of Claims upheld damages caused by cancellation of the contract between the Atomic Energy Commission and the Dixon-Yates group to build a power plant in Tennessee to supply the Tennessee Valley Authority. The Court of Claims upheld the damage claims, on the ground that both Bureau of the Budget and Atomic Energy Commission officials at the time were aware of Wenzell's relations with First Boston but did nothing about it.

Hearings Set for Snake–Bridge Canyon

Two major hydro power project battles—in widely separated areas of the West—have been assigned hearings dates by the Federal Power Commission. In announcing the hearings, FPC has set up new procedural ground rules that will affect all similar cases in the future.

The controversies are: (1) Pacific Northwest Power Co's proposed High Mountain Sheep Dam and Washington Public Power Supply System's proposed Nez Perce Dam, on the Snake River between Idaho and Oregon; and (2) Arizona Power Authority's proposed Bridge Canyon-Marble Canyon Dams and the City of Los Angeles' proposed Bridge Canyon project, on the Colorado River, Ariz.

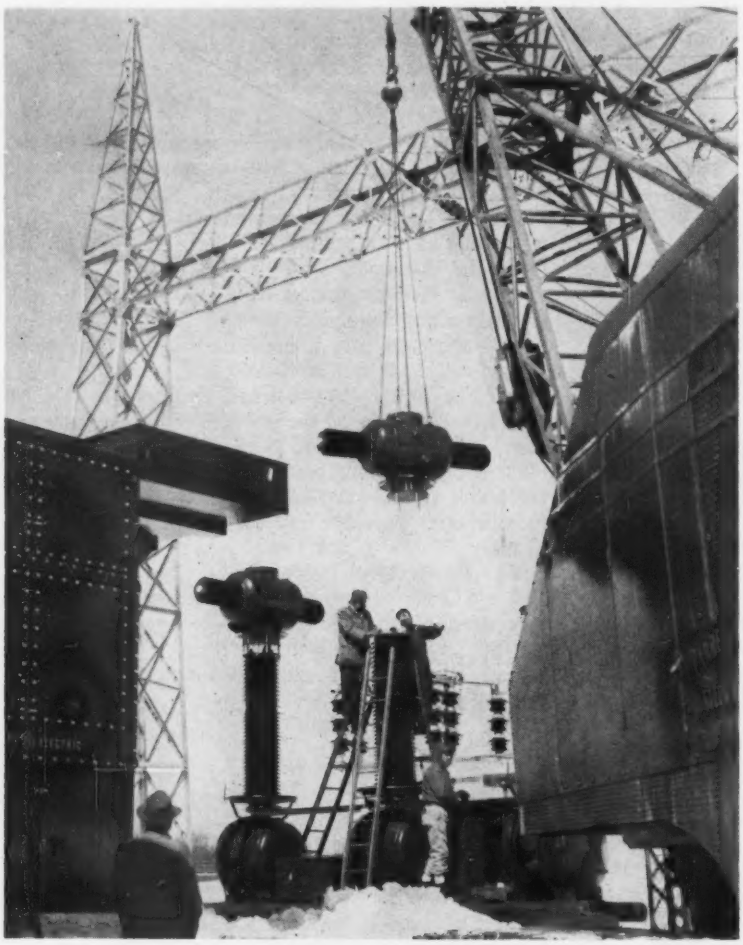
FPC has set July 18 for the High Mountain Sheep-Nez Perce hearings; September 12 for Bridge Canyon applicants.

A new procedure for accepting direct testimony in these controversies—almost surely to be used again in the future—has been ordered by FPC. It is aimed at saving time, expense, and preventing possibly unfair advantages to one party or the other. The procedure calls for simultaneous filing of all direct testimony, in writing, in advance of the hearing. Hearings, scheduled about two months later, would be devoted to cross-examination of this evidence and followed by evaluation.

Direct evidence by applicants in the High Mountain Sheep-Nez Perce hearing is due May 16; intervenors' testimony must be filed by June 16. Direct evidence in the Bridge Canyon hassle must be filed by July 5, and intervenors' testimony filed by August 8.

FPC estimates that this procedure may cut hearing time in half. And it prevents possible advantage or disadvantages to competing applicants who would otherwise be required to present, orally, their direct testimony either ahead of, or after their competitor.

PNP's High Mountain Sheep project ($78 million, 1.75 million kw) had been set for March 21 hearings, but the Washington PUD application for Nez Perce ($276.5 million plus, 2.4 million kw) forced a delay and consolidated hearings. Similarly, Arizona's Bridge Canyon-Marble Canyon development ($347.3 million, 1.45 million kw) was held up for FPC hearings until it could be consolidated with the rival Los Angeles application for a single Bridge Canyon project ($243 million, 1 million kw).



Project EHV Gets New Type Breaker

This new three phase, 15-kv air-blast circuit breaker was installed in less than seven hours from rail siding to complete assembly in General Electric's Project EHV North Substation, Pittsfield, Mass.

The breaker's interrupter head is being lowered for installation in the photo above. The breakers will protect station equipment on the prototype super-high-voltage transmission system.

Democrats Will Support Hanford Generation Plan

Congressional Democrats won new support last week for legislating electric power from the Hanford, Wash., plutonium reactor now under construction.

Democrats on the Joint Committee on Atomic Energy in Congress decided to go for broke for authorizing dual purpose production at Hanford as hearings on the Atomic Energy Commission's construction program for the fiscal year starting

next July 1 got under way.

"I will recommend acceptance as a budget item," said Rep Chet Holifield, (D-Calif.), subcommittee chairman on legislation. Sen Henry Jackson, (D-Wash.), in whose state the project lies, seconded Holifield's motion.

The new support for convertibility-to-power came in a special cost analysis completed by the R. W. Beck Co, a consulting engineering firm of Seattle which has worked in the past on public power projects. Beck was asked by the committee to review all studies previously made on the feasibility of converting NPR to power, including the recent Federal Power Commission evaluation.

Ohio Towns Undecided On Systems Tie-in Plan

A group of three, formerly four, municipalities in north central Ohio is still talking about building a tie line to connect their various electrical systems. Willard, Ohio, has withdrawn from the group.

Latest in a series of meetings before press time was held in Shelby Mar. 30 with representatives of Norwalk, Shelby, and Oberlin in attendance. Progress to date: utility men from each of the municipalities were to meet April 6th, draft a letter of objectives, contact several engineering firms, and arrange for an exploratory meeting between engineers and the municipalities looking toward an engineering feasibility study.

The group wants the study to include an aerial survey for the proposed right of way, cost estimates of construction, and a delineation of problems which might be encountered, but it doesn't want to spend more than $5,000 to get it. One of two things might result: there may be a distinct lack of engineering firms willing to undertake the job for the proposed fee; or the city councils of the group may have to throw cold water on the engineering study for money reasons.

The Public Utility Commission of Oberlin is currently studying a report by a Michigan engineering firm to decide whether the city should continue in the electric utility business.

Partnership Used in California

The "partnership" concept—on the local level, at least—was given a boost last week when Pacific Gas & Electric Co and Oroville-Wyandotte Irrigation District signed a 50-year contract under which the utility will buy power from the district at a price of $3.16 million per year. The money is expected to cover all costs of building and operating the long-planned $62-million South Fork Feather River Water and Power project.

Construction bids will be opened at Oroville May 12 by Bechtel Corp, engineering consultant for the District. District officials hope to see construction underway by summer, and completion by mid-1963 is scheduled.

The District is pledged to issue bonds to the limit of PG&E support, up to a $62 million limit, under authorization of a 1958 bond election. Bond money will finance construction and interest costs until PG&E payments for power come in.

South Fork project was originally scheduled to get underway one year ago, but was delayed indefinitely when no bids were submitted on several construction schedules. High interest rates were blamed at the time for lack of enthusiasm on the part of construction people.

If construction bids are satisfactory, the bond issue will be shortly thereafter.

The watershed to be developed is in the Sierra Nevada range above Oroville in northern California. Average annual rainfall is 70 in., of which a substantial portion will be retained for power, irrigation, and domestic use.

Project will impound 163,000 acre-ft. Two storage dams and four afterbays and diversion dams will be built. Three powerhouses, Woodleaf, Forbestown, and Kelly Ridge, will have total generating capacity of 86,500 kw. Also included in the project are 17 miles of tunnel and 23 miles of canal for irrigation water delivery.

In another development, Gov E. G. "Pat" Brown, in a letter to Sen James E. Murray, chairman of the Senate Interior and Insular Affairs Committee, asked for a delay on the proposed Bonneville-PG&E tie until a study he has commissioned is completed (See p 12). He also pointed out that "Among other things, the new study may well indicate the feasibility of utilizing the California portion of such a line to transfer power developed at Oroville Dam, the key reservoir in the water development program being undertaken by the State of California."

Peace River Company To File Applications

Peace River Power Development Co has been authorized by the government of British Columbia to make applications to the Public Utilities Commission and then to the Water Rights Branch for the necessary license and certificate for its Peace River project.

Next step for PRPD is to negotiate and secure power sales contracts with its major customers, British Columbia Electric Co and British Columbia Power Commission. It can then go to the PUC, and it is here that all the pros and cons of the project are expected to be brought out in hearings.

Authorization to proceed with applications came from Ray Williston, lands and forest minister, following a general approval by A. F. Paget, water comptroller, after a three month study of the plan.

Sen Aiken Compliments Co-op National Ads

Sen George Aiken (R-Vt.) compliments 25th anniversary advertising program of the National Rural Electric Cooperative Assn as being "in contrast" to the "destructive" and "full-page advertising in our national magazines directed at discrediting the rural electrification cooperatives."

Aiken characterized NRECA ads as attempting to build up, not tear down; expressing pride and faith; making no attack "upon those who would destroy the cooperatives." He adds that these ads declare, "in effect, that it is not necessary to destroy some other business in order to build up your own. . ."

FHA's MASON, left, told heating men of his agency's new attitude toward electric heat. NEMA's Miller pointed to growth, including heating, in 60's

First Electric

- NEMA Chicago meeting attracts power suppliers, manufacturers, distributors, dealers and contractors
- Huge attendance evidences broad interest in electric heat and heat pumps
- Mineral Wool Assn puts out new insulation standards

More than 3,000 representatives of electric utilities, cooperatives, manufacturers, distributors and dealers converged on Chicago last month to attend the First National Electric House Exposition and Symposium. The three-day affair (March 21-23) was staged by the Electric House Heating Equipment Section of National Electrical Manufacturers Assn.

The heating men were everywhere in the "Loop's" Sherman Hotel. On the mezzanine they crowded the more than forty equipment displays of everything from simple controls to a complete all-electric home model. They filled the chairs, then the balcony, then the carpeted steps and stairways of the grand ballroom to hear speakers run the gamut from new house insulation standards to the setting of rates. They buttonholed each other in the corridors for product lines, promotional rates, distributorships and information.

Enthusiasm Is 'Unbelievable'

The enthusiasm of the meeting—and perhaps its greatest significance—was best expressed by one veteran electric heating conference-goer, when surveying the crowd, he said, "This is unbelievable! A few years ago there was only a handful of people—a few manufacturers and some far-sighted utilitymen—who were interested in electric heating. Look at this bunch today . . . look at how much the base (for heating) has been broadened. From here on in, it's only a matter of time before electric heating hits the major leagues."

And, judging from the interest and response shown by the conferees, it would be difficult to deny he was right. Some of the highpoints of the program:

• **FHA interest in electric heat**—The attitude of the Federal Housing Administration toward electric heating, particularly that of the FHA's field offices, has traditionally been anything but favorable. But this is changing, now that better methods for calculating heat losses and operating costs are being perfected. The new look was expressed by Assistant Commissioner for Technical Standards W. Beverly Mason Jr, when he told a general luncheon session that FHA no longer considers electric heat a novelty, but "an increasingly important, modern, and—with proper standards—a feasible method of house heating."

• **Electric heating in the future**—Joseph F. Miller, NEMA's managing director, outlined the trends in electrical growth over the next decade. Seeing a 120% increase in electrical energy sales (745 billion kwhr) in the next 10 years, Miller pointed to the NEMA forecast in the same period of six million electrically heated homes.

• **Equipment standards and safety**—More than one speaker touched on the matter of equipment standards, safety, and the related views of Underwriters' Laboratory and the insurance companies. While UL Pres M. M. Brandon interpreted the Electrical Code for electric heating, Electromode's Lowell Mast related the code to standards for resistance equipment. The importance of realistic equipment standards to the industry was emphasized again and again.

• **Heat pumps**—Although the NEMA section is made up of resistance equipment makers exclusively, the program included a symposium on heat pumps. Under the guidance of Arkansas P&L's Les Blades, manufacturer and utility speakers pointed out the potentials and the pitfalls of the heat pump. GE's R. D. Roley called for standards to guide northern and southern users of heat pumps. Fred Reed, chief engineer, Air Conditioning & Refrigeration Institute, gave the inspector's view of them.

• **New insulation standards**—Standards that tell a home owner how well insulation in his house will perform were announced by National Mineral Wool Assn.

The new standards are built around an installed resistance factor, "R", which is the reciprocal of the "U" value now used. The "R" number—to be stamped on all insulation products put out by the association's members—is an "installed resistance" factor (See note at bottom of table on opposite page). It will indicate the amount of heat the insulation, plus adjacent air spaces and surfaces, will keep from escaping from a house in winter or entering it in summer.

There are three standards, depending upon the performance desired. The first, for electrically heated and air-conditioned houses, conforms to an "All-Weather Comfort Standard." This new standard, also announced at the meeting, was established by a group of utility, manufacturer, and insulation representatives.

House Heating Exposition Draws 3,000

The other two standards for given levels of insulation effectiveness are "Reasonable Comfort and Economy," and "Minimum Acceptable Comfort." The "U" values and "R" factors for both appear below.

While the foregoing represents some of the highlights of the exposition and symposium, the general premise that electric heating and the heat pump have come of age was followed by almost all the speakers.

Market Worth $1 Billion Annually: Kreiser

NEMA Section Chairman C. F. Kreiser (Wiegand Co), in a pre-conference press session, claimed that the electric heating market, with its 6-million-homes goal by the end of the decade, will soon reach the $1 billion annual level in equipment sales and labor. Turning to the auxiliary market, Kreiser forecast said that some $23 million has been spent so far for electric heating units for spare rooms, bathrooms and other locations. He forecast cumulative expenditures for such equipment of $72 million by '65 and $191 million by 1970.

Another section member—and the man generally recognized as responsible for the conference itself—Stanley Aronson (Berko), told the final general session that a minimum of 100,000 electrically heated homes will be added to the total this year. (This is somewhat higher than the 75,000 predicted by Electrical World at its heating conference last fall.) "We believe," Aronson said, "that we are not at all over-optimistic in setting the following figures as the minimum basis for estimating future sales at retail installed costs (equipment plus labor): 1961—$210 million; 1962—$300 million; 1963—$400 million; 1964—$550 million; and 1965—$750 million."

Detroit Edison's A. E. Sangster, in a speech titled "Electric Heating Has Come of Age," outlined his company's programs to promote the load. He emphasized a five-week course for architects and consulting engineers, the men whom Detroit Ed feels are the keys to success in the industrial and commercial markets.

Although the conference stuck close to operating and installation problems, it did make a distinction between public and private power when it scheduled a special panel session for municipals and rural electric co-ops.

Perhaps this distinction was justified on the basis that several large municipals in the TVA area are serving the heaviest blocks of heating load in the country. TVA's Supervisor of Commercial and Industrial Power Use Buford H. Martin treated in some depth the considerations involved in serving such loads. One of Martin's most interesting points challenged the "false assumption . . . that the full connected . . . heating load will be added on top of the demand for other uses." Martin says TVA has many examples to "demonstrate that the incremental demand resulting from electric heating is . . . 40-50% of the connected load."

Leland H. Olds outlined a plan for setting rates for electric heating based on his long-standing scheme for a nationwide super-transmission grid. "Under a mandate to adjust costs to make all-electric living feasible, engineers and other experts assigned to the power supply function, can bring the cost of 70% load factor power delivered to distribution facilities down to range from 0.51¢ per kwhr in low-cost fuel areas to 8.1¢ per kwhr in high-cost fuel areas." Under a similar mandate to cut distribution costs, Olds sees incremental distribution costs of 0.1¢ per kwhr for municipals, 0.4¢ per kwhr for rural co-ops, and 0.2¢ per kwhr for private utilities, "with average consumer densities."

New Insulation Standards of National Mineral Wool Assn

ALL-WEATHER COMFORT STANDARD

	U Value	R Factor
Ceilings	.05	20.0
Frame Walls	.07	14.3
Floors over vented crawl spaces	.07	14.3

REASONABLE COMFORT AND ECONOMY

	U Value	R Factor
Ceilings	.07	13
Frame Walls	.09	8
Floors over vented crawl spaces	.09	9

MINERAL WOOL 'R' FACTORS (AWCS*)

	R Factor	U Value
Ceilings	19	See
Frame Walls	11	note
Floors over vented crawl spaces	13	below

MINIMUM ACCEPTABLE COMFORT

	U Value	R Factor
Ceilings	.10	9
Frame Walls	.11	7
Floors over vented crawl spaces	.11	7

*R FACTORS FOR ALL-WEATHER COMFORT STANDARD—These standards, arrived at by National Mineral Wool Assn, are designed to reflect the 'installed resistance' of the mineral insulation in the wall. The difference between them and the 'R' Factors in the All-Weather Comfort Standard table is accounted for by the fact that the other structural elements in a building —siding, board, plywood, plaster, etc—have measurable resistances to the flow of heat either in or out of the building.

Crews Brush Up in Bad Weather

Supervisors plan ahead for combined work and training program; crews check tools, make repairs, learn techniques

J. R. DUNIGAN, Vice President, Planning, Public Service Co of Indiana, Plainfield, Ind.

Public Service Co of Indiana is turning the problem of effective use of outside line crews during inclement weather into an asset. An inclement weather work program, developed after considerable research and planning, has produced notable improvement in crew performance.

Responsibility for carrying out the program is placed with the regular operating chain of command with assistance given by the safety engineer. The first hurdle overcome in preparing the program was that of determining what constitutes inclement weather. This was spelled out as clearly as possible to promote uniformity of practices and eliminate grievances. However, it is recognized that there is no completely satisfactory definition of inclement weather.

By supplying supervisors with logically-grouped check lists of productive work, not all of which would ordinarily be left until bad weather, useful reminders of things to be done were available. For the most part these are routine tasks that do not require close supervision.

The four main groups covered in these lists are:

1. Protective devices and equipment.
2. Tools and work equipment.
3. Automotive equipment.
4. Storeroom, garage and service building work.

Some specific duties were suggested. Typical of these are:

1. Build bins, shelves and storage space as needed.
2. Assemble material for future work orders.
3. Recondition materials in storeroom for future use.
4. Clean, repair and paint tool racks and compartments in truck.
5. Check flares and supply of fuses; clean and refill flares.
6. Sand down and refinish live line tools, shovels, pike poles.

To provide specific aids to superintendents and crew leaders, the safety engineers added a number of brief illustrated instructions, diagrams and pictures.

As a complement to productive work the program includes two sections on training, often under simulated job conditions. The first is job training in working with live line tools, safety and work methods, job proficiency using chalkboard talks, and general line work practices. The other is first aid.

The job training area covers such items as live line tool use, rigging, splicing, pole handling, and diagramming transformer hookups. To help in these assignments, indoor training poles were set up.

Typical training assignments have included: the installation of live-line wire grips; cutting and splicing ACSR conductors; replacing pin and post-type insulators; and cutting and splicing a conductor at a dead-ended, 12.5-kv circuit and cutting in an extension link.

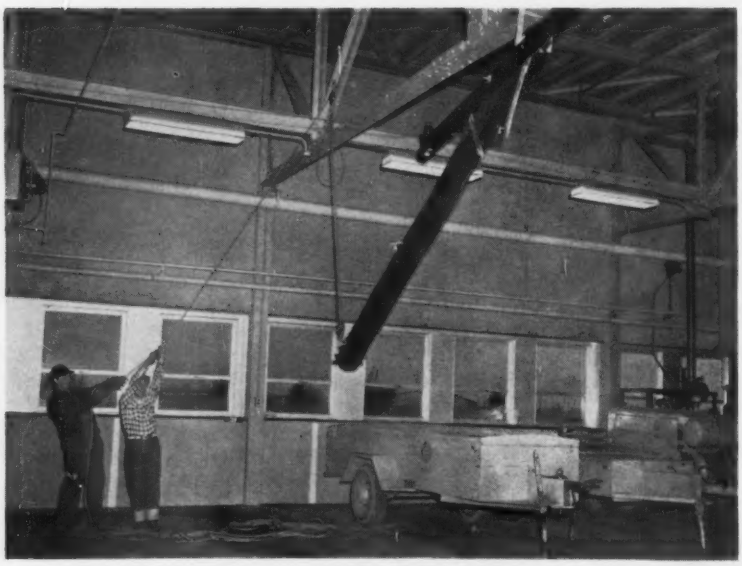
Training Improves Teamwork

This training is of great value in improving crew teamwork and knowledge and in discovering and strengthening individual weak spots. Results are generally apparent in daily work.

The PSCI program also includes advance planning and scheduling of inclement weather activities. The slogan has been: "Advance scheduling will return more time than it will take." Supervisors have become increasingly aware of this.

To help supervisors in planning and scheduling, as well as in reviewing results, two forms have been prepared. One is preliminary and is titled "Notations For Proposed Inclement Weather Work." On it the supervisor assembles what should be done the next time it rains or snows and how long each assignment will probably take.

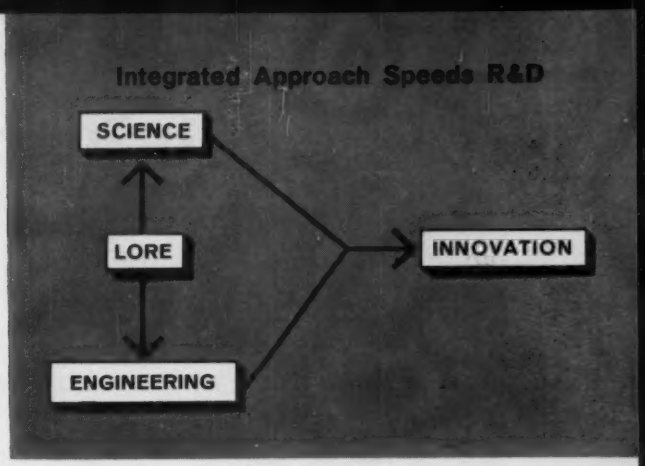
The other form, covering a calendar quarter, is the "Inclement Weather Work Record" on which the dates of inclement weather days and the number of man-hours spent on each type of work or training assignment are recorded. This helps to balance assignments over a period and provides information to management on areas covered in the program.



INDOOR TRAINING POLES were installed to help with training. These, installed in a garage, can be quickly hoisted out of the way when not in use

A Special Report

Research & Development



Spark Industry Breakthroughs

LEONARD M. OLMSTED, Senior Editor

■ Sensational innovations at an accelerating pace seem assured for the electrical industry's future. Research and development schedules today list more than enough projects to shatter all records set in eight decades of meteoric growth. And the quickening tempo of basic research promises enough new breakthroughs to keep development schedules in high gear.

But these innovations will not come overnight. As General Electric Co's Chairman R. J. Cordiner observed nearly two years ago, "the main patterns of today's electrical industry were fundamentally determined by decisions made, battles won, funds invested, facilities built, and research launched ten or 20 years ago. The shape of things to come is being determined now—in the executive offices, in the laboratories, . . . and in the minds and hearts of men."

Research and development expenditures have, for the past three decades, grown faster than gross national product. Private funds allotted to R&D have doubled in percentage of GNP in the past five years, after decades at an average of 0.7%. Government appropriations, spurred by defense needs, have soared to a comparable level.

This emphasis on R&D has already produced a sensational surge of technical information. The adaptation of new discoveries has been speeded by a closer association of scientists and engineers (see chart) in what General Electric's J. F. Young calls the "integrated approach" to distinguish it from the classical "sequential" flow of ideas from discovery to education to engineers who apply this knowledge to innovations for public use.

R&D teams set up to apply this "integrated approach" usually draw members from many disciplines to focus their specialized lore and skills on assigned objectives. Dramatic examples of their effectiveness are the crash development of the atomic bomb, which speeded the end of hostilities in 1945, and the subsequent application of fission energy to ship propulsion and power generation. Cross-pollination of ideas in such research teams—or task forces, as they are sometimes called—makes for speedy adaptation of the innovations of one industry to the needs of another.

Research for the power industry is, in the scientist's vernacular, mostly the applied variety. For it is aimed toward assembling working knowledge to enable development engineers to build prototypes which will demonstrate the value of innovations. Numerous task forces are working in this area today, some set up entirely within one manufacturer's organization and others, particularly those sparked by utilities, comprising representatives of numerous participating utilities and equipment suppliers.

Such R&D task forces give the electrical industry new power to slash to a few years the traditional half-century time lag between discovery and innovation. But they do not supplant pure research which, in its quest for new knowledge of the laws of nature, turns up discoveries to spark new R&D projects and speed breakthroughs for task forces already committed.

The tempo of research today has climbed to new heights. It has amassed the power to produce a galaxy of innovations for tomorrow's power systems. A sampling of these expected innovations, revealed in conferences with research organizations from coast to coast, is evaluated on the following pages.

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R&D

Teams Push Fusion, Fission, and Exotic

Other projects explore solar, wind, and tidal power as well as steam from earth and ocean

■ Spurred by predictions that the world's fossil-fuel resources will be exhausted by 2075, R&D teams around the world are pushing projects to tap new energy sources. Potential sources are:

Deuterium from sea water.
Energy from the sun.
Wind.
Ocean tides.
Ocean temperature differentials.
Geothermal steam.
Uranium and other fissionable materials.

Most promising of these energy sources appears to be deuterium extracted from sea water, considered an almost inexhaustible source in that every gallon of water contains enough energy to match 300 gal of gasoline. But use of this fuel depends upon raising it to an "ignition temperature" variously estimated at 10,000,000K to over 50,000,000K to force collisions betwen nuclei of deuterium atoms, commonly called "fusion." Ignition in the H-bomb was a one-shot problem. But continuous confinement and control of a self-sustaining reaction must be achieved before fusion can provide useful power.

Controlled Fusion Expected Soon

Achievement of ignition temperature within the next year or two was predicted by Dr. Arthur Ruark, director of Atomic Energy Commission's Project Sherwood. Facilities at five laboratories will by then be testing different methods of creating and containing hot hydrogen plasma and maintaining a fusion reaction for a few μsec.

One of these, the $35-million C-Stellarator at Princeton University, will circulate deuterium enriched with tritium around a high-vacuum 40-ft "race track" of 8-in. stainless-steel tubing. The gas, after initial 40- to 100-kc voltage discharges strip off its electrons to ionize it, will be stabilized through the center of the tube by a succession of magnetic fields. The plasma will then be heated to about 1,000,000K by currents up to 50,000 amp induced in it by coupling transformers from discharge pulses of large capacitor banks. Additional heating will be applied by "pumping" the plasma's nuclei with 30 to 200-kc RF fields set up by currents up to 700,000 amp in coils encircling the tube. Final heating will be applied by exciting plasma at the natural rotational frequency of its nuclei from another RF source.

Project Sherwood has other experiments in plasma heating and confinement at Los Alamos and at University of California's Radiation Laboratory. And the Oak Ridge Laboratories are plying a deuterium beam with an intense carbon arc to drive its deuterons into a magnetic field which may sustain thermonuclear temperature.

In another massive attack, General Dynamics Corp's General Atomic Division is injecting deuterium plasma into a magnetic "bottle" as part of its $10-million research program with 11 utilities operating as Texas Atomic Energy Research Foundation.

Major obstacles block the road to successful fusion power. Some of these may exceed the capabilities of today's scientific skills. But potential benefits are great enough to assure unflagging assaults. Informed estimates are that several decades may elapse before men learn to build fusion reactors and that, when they do, they may have to be extremely large to produce economical power.

Solar Energy Capture Inefficient

While these R&D teams struggle to achieve controlled fusion on earth, others turn calculating glances toward the world's oldest and only operating fusion reactor—the sun. For astrophysicists today seem agreed that the sun is just that, with internal temperatures exceeding 30,000,000K. They reason that its gravitational force prevents the escape of ionized plasma from its controlled fusion reaction. So it has reacted continuously through the ages, radiating incredible quantities of electromagnetic energy. The infinitesimal portion of this radiation which strikes the earth as light and heat is a thousand times greater than foreseeable energy requirements.

Every sq foot of horizontal ground in the U. S. receives solar energy at from 0.15 to 0.75 kwhr equivalent per day. But the best solar cells today have efficiencies of only 10 to 12% so the available electricity is only 0.015 to 0.090 kwhr per sq foot per day. A home consuming 10,000 kwhr per year would need 500 sq ft or more of collecting surface—and extensive facilities to store energy for dark periods.

Technical feasibility of solar power has recently been demonstrated with an electric automobile in Los Angeles. As devised by International Rectifier Corp, the antique auto carries on its roof a 26-sq-ft $15,000 panel with 10,640 selenium cells connected to charge the vehicle's 115-v battery at 100 watts in direct sunlight. Improvements are expected to double the panel's output and cut it's cost to under $3,000.

Another system, under study by Lockheed Aircraft, contemplates using solar energy to electrolyze water in regenerative fuel cells. Energy stored in the gases would be re-converted to electricity when needed. And International Telephone & Telegraph Co has proposed ferroelectric capacitors to convert heat to electricity.

Nearly a sq mile of receiving surface would be needed to power a 100-Mw load, according to United Nations estimates. They concluded: "Solar energy is able to do much of the world's work and supply much of its heat. . . . The long-range hope lies in direct conversion into electricity or conversion through chemical reactions. Much basic research is needed."

Wind power is sometimes proposed as an energy source as universal as solar energy. But the problem is purely economic, for engineers have long been able to achieve acceptable efficiencies in harnessing winds.

Power Sources

There is a long list of power-producing mills, mostly in Europe, but the largest of them all pumped up to 1,250 kw into a Vermont utility's lines until it was abandoned.

Ocean Power Progressing

Tides in the ocean are another of Nature's bounties. And for several centuries man has sought to put them to work. The Bay of Fundy, with the highest tides in the world (up to 52 ft), has been studied, as has Passamaquoddy (Cobscook) Bay nearby. Both were dropped as uneconomic, some years ago, but a $687 million international approach has recently been proposed to provide 560 Mw of firm capacity at 8.4 to 11.5 mills per kwhr.

Interest is higher in France where Electricite de France is installing 342 Mw of horizontal "bulb" hydro units in a barrage across the Rance estuary. Tides up to 37 ft are expected to generate 820 million kwhr per year. E de F sees an ultimate 20 billion kwhr annually along the Channel coast.

Research requirements of tidal power do not appear large. But there is acute need for more extensive knowledge of marine dynamics to guide the design and to guard against upsetting the "tuning" which makes for tidal concentrations.

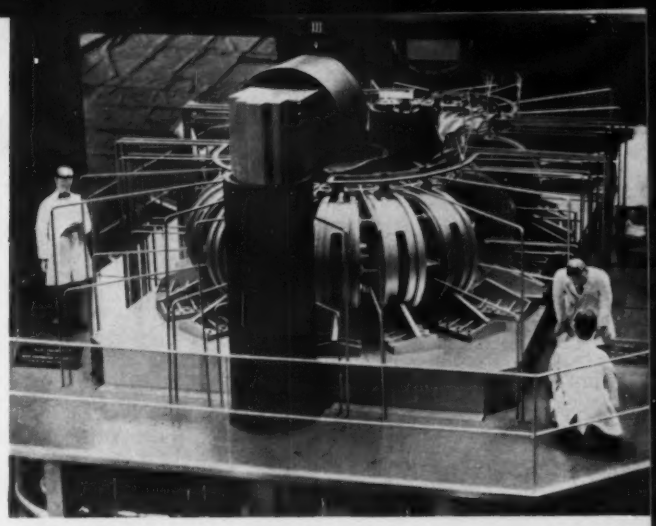
The seas also hold energy in the form of heat which can be released by flashing vapor from it in the partial vacuum created by condensing the vapor with colder water. Directing this vapor through a low-pressure turbine extracts mechanical energy, with potable water as a by-product. Power capability depends upon the square of the temperature differential, 36F being about the minimum.

Feasibility of this method depends upon finding sites, mostly on tropical coastlines, where available water provides the temperature differential. One such site, selected by Societe Energy des Mers, is Abidjan on the African coast where a submarine canyon brings cool water within three miles of a warm lagoon. Here again the remaining problems are economic rather than R&D. Methods are available for engineers to apply wherever the need for electricity and potable water develops within reach of a suitable site.

Geothermal Steam Harnessed

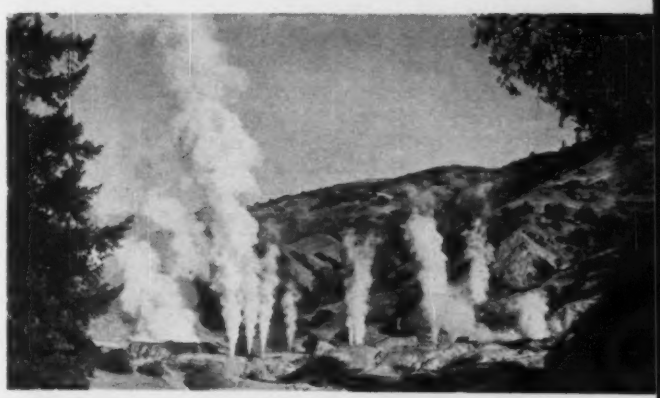
Geothermal steam is another energy source which can be put to use. The concept is not new, for the Italians coupled a steam engine to a Larderella steam jet in 1904. Steam temperatures there run up to 460F with some super-heat. Nearly 6 million lb/hr is extracted from Italian wells today to generate 400 Mw and reclaim as by-products the substantial traces of sulfur, boric acid, ammonia, and other chemicals.

The world has many other locations where hot springs or steam plumes attest to geothermic energy. In the Wairakei-Kamerau volcanic region of New Zealand saturated steam from 2,000-ft wells will soon drive a 37.5-Mw generator and 475 Mw is anticipated. Superheated steam from 600-ft wells at the Geysers in California's Coast Range will next month roll a



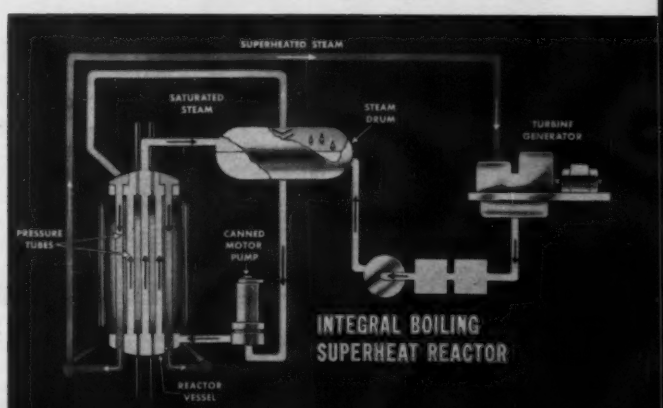
STELLARATOR'S "RACETRACK" will speed plasma . . .

. . . in corner of new $35 million Princeton laboratory



GEOTHERMIC POWER to be harnessed at California wells

NUCLEAR SUPERHEAT will boost A-plant power economy



12.5-Mw automatic pilot plant for Pacific G&E Co at 100 psi, 348F. A second unit is planned but Thermal Power Corp, with eight other sites under lease, is talking 100 Mw. Thus geothermic steam seems ready for development without further R&D whenever economics and its proximity to load, prove favorable.

A-Power On Schedule

Fission is not quite in the same class because it does consume fuel which is not unlimited. But it is considered by many the best hope for 200 years.

Fission projects are moving substantially on schedule. At least one atomic expert insists that the 1954 prediction of economical power within a decade will prove correct. Progress has been good, he observed, and some utilities will soon be able to justify an atomic plant "as an investment rather than a contribution to the art."

Progress has been sensational. Less than two decades have elapsed since Dr. Fermi first demonstrated the feasibility of the self-sustaining chain reaction at Chicago's Soldiers' Field behind screens of military security—screens only gradually removed after the U. S. Navy in 1955 demonstrated atomic power with the submarine Nautilus.

The physical feasibility of nuclear generation for utility service could be—and at Shippingport has been—demonstrated with a plant developed out of naval experience. But a massive and costly R&D program must still be completed before atomic plants can win economic acceptance. Expenditures on this by AEC and cooperating industry already exceed $700 million and the work is far from done.

Vital portions of this R&D can only be done with a progressively more complicated series of essentially full-scale plants. Several of these—notably Nuclear Power Group's 180-Mw $51-million Dresden Plant on the Commonwealth Edison system; Yankee Atomic Electric's 134-Mw $57-million plant on the New England Electric System; and Power Reactor Development's 100-Mw $55-million Enrico Fermi Plant on Detroit Edison's system—are scheduled for initial operation this year. First of these is in the boiling-water series and designed to produce steam at 1,000 psi, 546F; the second, pressurized-water to produce steam at 500 psi, 470F. The third is a fast breeder and should produce steam at 600 psi, 740F.

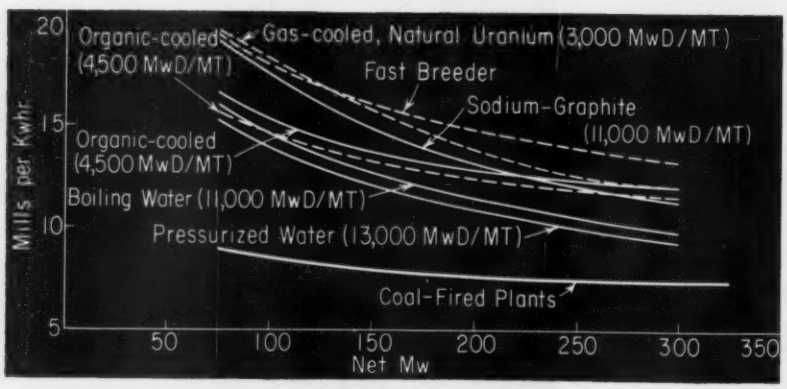
Evaluation of these commercial operations should provide important corrections on estimates and a firm take-off for further R&D projects. Already heavy assaults have been mounted against economic barriers disclosed by these designs, such as costly containment and steam conditions unfavorable for turbine input. The former spurred Sargent & Lundy to experiment at Illinois Power's Hennepin Plant with cold water around the reactor to "squelch" any escaping fluids. Pacific G&E has attacked containment costs at the proposed 60-Mw BWR addition to Humboldt Bay Station.

Superheat, Gas Cooling Attractive

Steam will be improved by superheat after it emerges from the reactor or heat exchanger. Consolidated Edison's 275-Mw PWR Indian Point Unit will get 40% of its capability by using an oil-fired superheater to raise 450F steam to 1,000F, and Rural Cooperative Power Association's Elk River Plant will superheat to 825F with coal. But Central Utilities Atomic Power (10) Associates' 62-Mw Pathfinder will superheat from 489 to 825F by circulating the BWR's steam back through the core. Allis-Chalmers predicts that further developments could lead to 1,050F superheated steam for turbines up to 400 Mw. General Electric, having demonstrated nuclear superheating at Vallecitos last year, and Westinghouse both include nuclear superheat in their programs to achieve competitive power costs.

Still another approach to higher temperature operation is the use of liquid sodium or gas as the coolant and graphite as the moderator. The SRE put in service two years ago by North American Aviation to generate 7.5 Mw for Southern California Edison is sodium-graphite, producing 600-psi, 825F steam. A later version is scheduled to produce 800-psi, 825F steam for an 81-Mw turbine next year for Consumers Public Power District at a total cost of 10 to 11 mils per kwhr. Additional research with Southwest Atomic Energy (15) Associates points to 1,800-psi, 1,000F steam from fission of uranium-thorium.

Most active of the gas-cooled projects—aside from Calder Hall and other British reactors—seems to be the High Temperature Reactor Development (52) Associates prototype scheduled to put 40 Mw into Philadelphia Electric's system in 1963. Burning uranium-thorium, it is designed by General Dynamics to furnish steam at 1,450 psi 1,000F. According to Allis-Chalmers, the gas-cooled reactor offers the ultimate potential of output temperatures well over 1,000F.



LARGE UNITS hold key to A-power approaching steam-plant production costs. These AEC estimates assume 35¢/million Btu coal, 80% load factor, 14% fixed charges

Industry Explores Energy Converters

Extracting electricity from heat and other potential energy forms spurs search in exotic areas

■ The most promising new energy sources release primary energy in the form of heat. It is not surprising, then, that the industry has redoubled efforts to improve the conversion of heat to electricity, even to considering such methods as:

1. Thermoelectric converters.
2. Ferroelectric converters.
3. Thermionic converters.
4. Magnetohydrodynamic generators.
5. Fuel cells.

Thermoelectric conversion, considered by many scientists to hold the most promise, is simply an adaptation of the Seebeck effect discovered in 1821 and used subsequently in every thermocouple. When certain metallic compounds, such as bismuth telluride, are substituted for conventional metals, the conversion efficiency approaches 10%. Research continues on other binary and ternary compounds and mixtures, some modified by semi-conductor techniques, in the hope of attaining the better-than-30% efficiency considered possible.

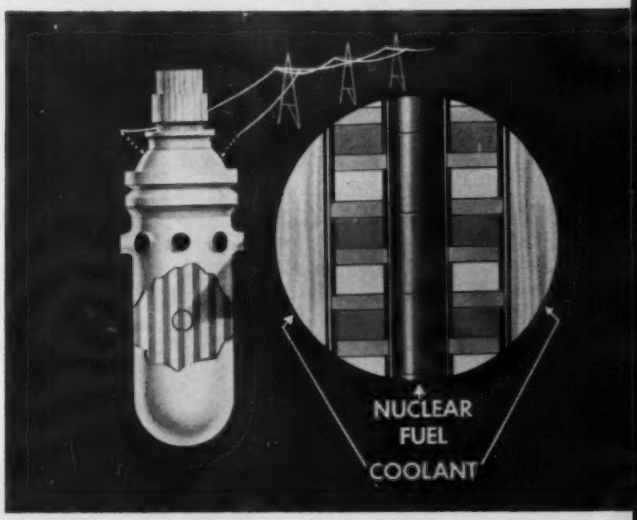
Efficient large-scale generation with thermoelectric converters depends, in part, upon raising the operating temperature to 2,000F or higher. Westinghouse has recently announced that samarium sulfide has good performance to 2,000F, and is studying reactor design in which uranium-oxide tubes heat surrounding thermoelectric elements whose "cool" junctions are bathed by the coolant.

Thermoelectric Feasible as Topper

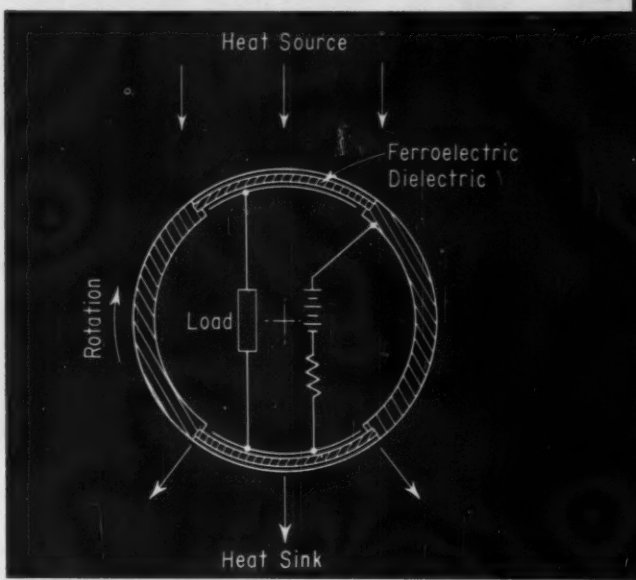
Other proposals contemplate using the thermoelectric converter as a "topper," taking off heat above the limit for the steam cycle in a plant heated by a nuclear reactor or by fossil fuel. Thus it appears probable that thermoelectric conversion may be ready for commercial use by 1970, provided the output can be used as dc, or an economical method is devised for converting it to ac.

The ferroelectric converter also functions on temperature differential. Essentially, it is a capacitor with a ceramic dielectric, such as barium titanate, whose permittivity drops sharply when it is heated beyond the Curie temperature. This drop in permittivity drives part of the charge from the dielectric to the plates, from which it can be drawn off as electricity up to 1,000 v per cell. International Telephone & Telegraph Corp envisions using this to convert nuclear heat to electricity. But extensive R&D is certainly needed to adapt this process to utility use.

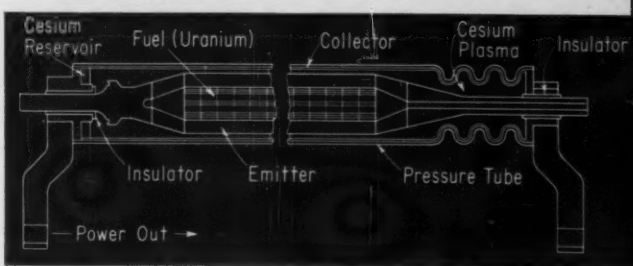
Improvements in the thermionic converter recently announced by General Electric Co have attained 17% efficiency in converting heat to electricity. Better than 30% is now considered possible, 82 years after discovery. Operation depends upon boiling electrons off a white-hot emitter into space filled with ionized gas



THERMOELECTRIC CONVERTERS along nuclear fuel rods will harness large temperature differential to coolant



FERROELECTRIC CONVERTER, rotated between heat source and heat sink, produces either dc or ac to 1000 v



THERMIONIC CONVERTER along nuclear fuel rods harnesses temperature differential to element's outer shell

(cesium) and catching them on a cooler collector to be taken off as current at approximately 1 to 2 v.

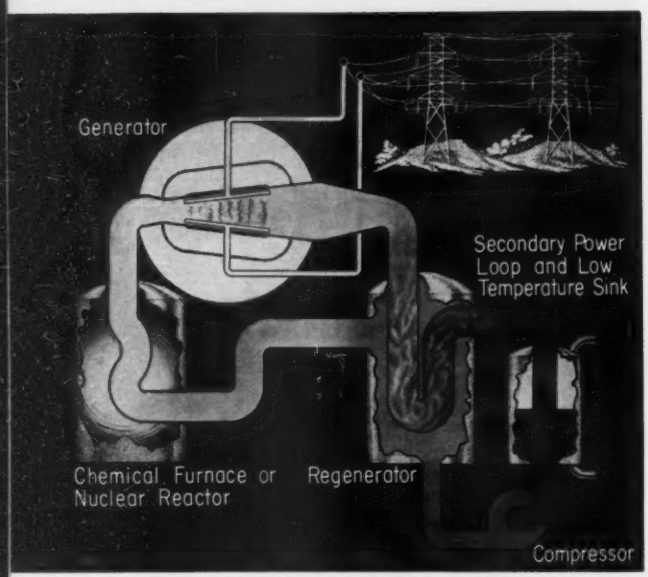
The ability of thermionic converters to operate at high temperatures makes them interesting as topping units for fuel-fired or nuclear plants. But many problems remain for study, such as:

1. Determining the phenomena of electron emission, space charges, and plasma.

2. Developing emitters for high temperatures.

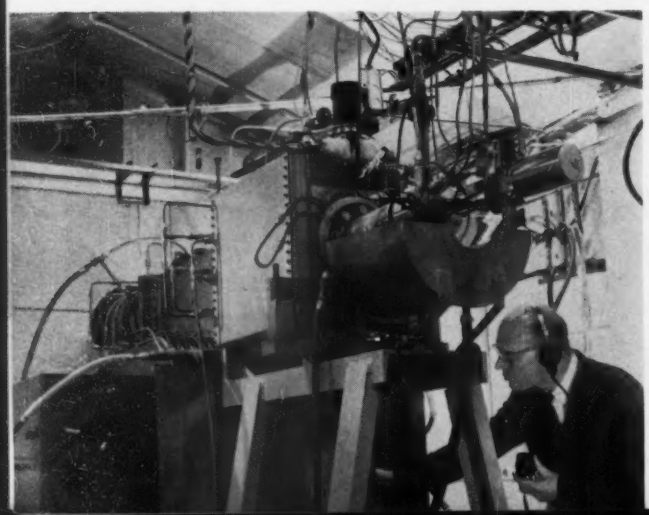
3. Developing stable collector materials.

A new thermionic converter, designed by General Dynamics and nine Western utilities to surround a reactor's fuel element, is expected to approach 30% efficiency. The emitter will operate at 3,500F, boiling off electrons to cross the cesium-seeded plasma to cold outer surfaces, where they will be collected as current. Series connection of many elements would raise their dc to a suitable level for conversion.



MAGNETOHYDRODYNAMIC CONVERTER extracts electrons from ionized gas between electrodes in magnetic field

EXPERIMENTAL MHD GENERATOR approaches 10 kw from the combustion of furnace oil in oxygen at 4,600 F



Meanwhile, Radio Corp of America and Thiokol Chemical Corp have proposed a thermionic converter to extract 30 kw from a rocket's exhaust within two years. Several additional years of work with emitter materials better than tantalum and tungsten are expected to boost efficiency toward a possible 64%.

MHD Generation Promising

Magnetohydrodynamic conversion leaped into focus as a promising power source with the announcement last November that 10 utilities, headed by American Electric Power Co, had joined Avco Corp in building a $350,000 100-kw coal-burning prototype. They hope to demonstrate, possibly before year's end, the performance and practicability of MHD generation.

Commercial application of MHD involves driving ionized gas at supersonic velocity through a strong transverse magnetic field. Electrons in the moving gas, like those in a moving wire, are deflected by the field to collectors from which they can be drawn as electric current. Even with ionization induced by cesium or potassium "seeding", the gas must still be at least 4,000F, a temperature which few solids can tolerate. Such a device could raise overall thermal efficiencies to 60%, said AEP's President Sporn, and cut power costs below those of today's most efficient plants. He and Avco's Research Director Kantrowitz envision MHD units, after ten to 25 years more R&D, as "toppers" for steam turbines in coal-fired or nuclear plants.

Meanwhile Westinghouse has built an open-cycle MHD generator to burn furnace oil seeded with potassium soap. It has operated for runs of 4 min and put out 5 kw. Combustion products in it reach 4,600F and 1,800 mph. But Westinghouse scientists look to the closed-cycle system, adapted to ac generation, as holding promise for indirect or nuclear firing.

Construction of such a plant involves formidable problems. The MHD generator for a 380-Mw plant would be 30 to 40 ft long and would have to sustain 4,000F continuously—very near the filament temperature of a tungsten lamp. Besides, a large combustion-fired gas heater or nuclear reactor would be required to operate at even higher temperatures. Westinghouse concedes that "a real breakthrough in materials" is prerequisite to the MHD power station.

Fuel cells have been proposed in many forms since man turned to space exploration. But the basic concept goes back to Sir Humphrey Davy, 1802, and Sir William Grove's "gaseous voltaic battery" of a few decades later. Because the fuel cell converts energy directly to electricity, it offers a potential efficiency approaching 100%, unhampered by the Carnot limitation.

Fuel Cells Reach 70% Efficiency

Many combinations of fuels, oxidants, and cell designs have been proposed. But utility engineers will find most interest in these two:

1. Hydrogen and oxygen, known as "hydrox".

2. Carbonaceous materials and air.

The hydrox cell illustrates the principle. As developed by Union Carbide Corp for the U.S. Army, it uses a porous carbon anode impregnated with platinum or palladium to catalyze into water the hydrogen molecules and hydroxyl ions from the potassium-hydroxide electrolyte. It also uses a porous carbon

cathode impregnated with cobalt oxide, platinum, or silver to catalyze the oxygen molecules and water from the electrolyte into hydroxyl ions. A 50-lb bank of such cells produced up to 1 kw at about 70% efficiency.

Hydrox cells work best on pure hydrogen. The electrolyte usually becomes "poisoned" if carbon monoxide, alcohols, or aldehydes are applied as fuel. But this seems to have been overcome by Allis-Chalmers Mfg Co in fuel cells used to power a tractor with propane and oxygen, probably using an acid electrolyte with nickel as a catalyst.

Output from the hydrox cell is stepped up by heating the electrolyte and pressurizing the gas. Thus the Bacon cell, developed by Cambridge Electronics Ltd and National Research Development Corp, produces 5 kw at 65% efficiency when operated at 390F, 400 psi. But pure hydrogen is too costly a fuel for commercial power production unless it is available as a by-product or is electrolyzed from water off peak.

Such carbonaceous fuels as methane, propane, kerosene, and natural gas are better used in fuel cells with molten-carbonate electrolyte at 900 to 1,600F. Consolidation Coal Co, using an equimolar electrolyte of lithium and sodium carbonate, has attained overall thermal efficiencies of 70 to 75% on natural or coal gas with air as the oxidant. But many problems, among them control of corrosion, remain for R&D before commercial application.

The redox cell also is considered promising for carbonaceous fuels. General Electric Co has found it able to use impure hydrogen or natural gas to regenerate a titanium hydride analyte which reacts at the anode in the conventional manner. The catholyte is bromides regenerated by air. This regeneration is preformed in external systems, making for expensive construction. This, and other problems, indicate that commercial application is years off.

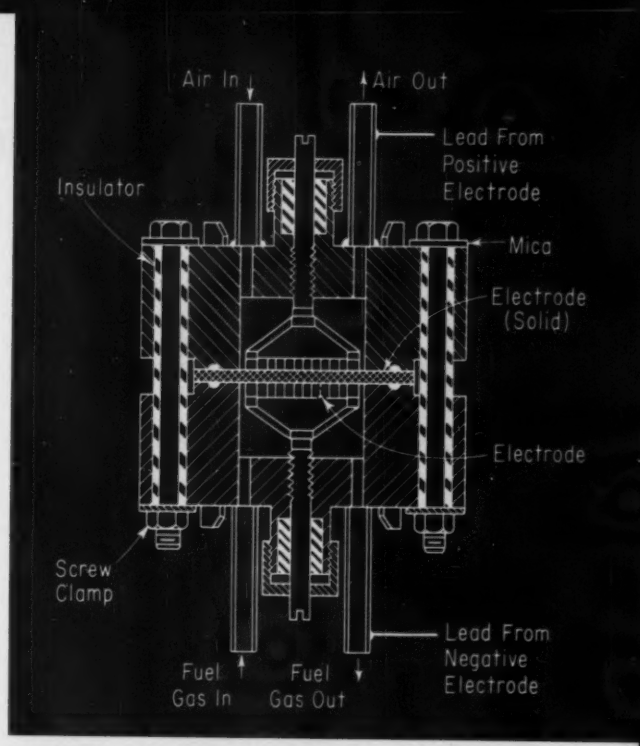
Conversion to Ac Poses Problems

Most of these new energy devices produce dc at a voltage much too low for efficient utilization or economical inversion to ac. Connecting individual cells in series is a step in the right direction. But getting the dc up to 500 v or more for reasonably economical, efficient inversion runs into new problems, one of which is insulation exposed to high temperatures.

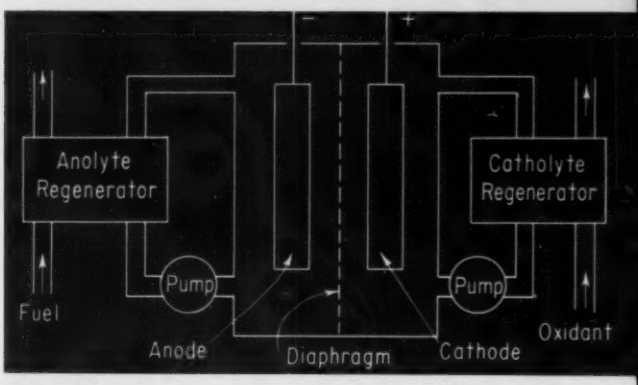
The inversion equipment itself appears to pose no serious problems other than cost. Research has produced the power transistor and trinistor which are ready today to control ignitrons on steel-mill drives, where braking is accomplished by using ignitrons as inverters feeding back into the ac supply.

These new semi-conductors are examples of the cross-pollinization of apparatus development with ideas spawned in communication laboratories. An early use of the transistor as an inverter was in Bell Laboratories' 30-w radio power supply for operation from low-voltage batteries. A slightly different circuit enabled N. V. Philips to put fluorescent lighting in Dutch buses and railway cars.

The power transistor and trinistor extend semi-conductor inversion to at least 1,000 v. And equipment for 60-kw output approaches 90% efficiency. R&D today seeks 10 to 100-Mw outputs at 95% efficiency at a cost below the $60 per kw of a 600-v ignition inverter.

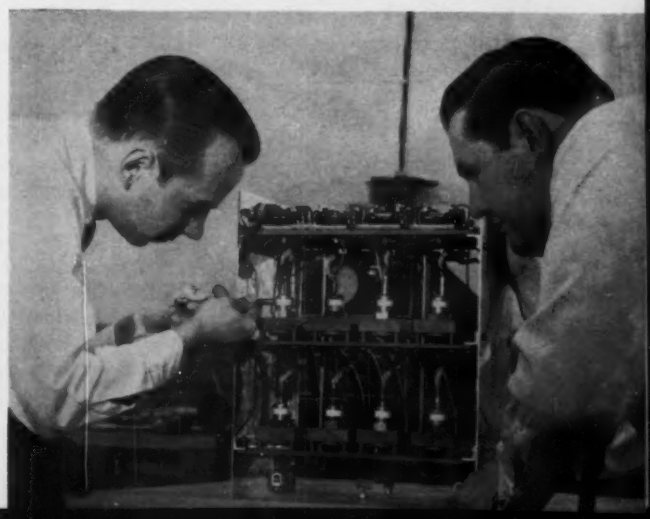


MIXED CARBONATES FUEL CELL extracts electricity from coal gas or natural gas at high operating temperatures



REDOX FUEL CELL uses carbonaceous gases and air in separate regenerators to activate the two electrolytes

POWER INVERTER using semi-conductors converts dc to ac, handles 15 kva efficiently with 8 trinistors in small space



R&D

Conventional Generation Benefits from

Supercritical designs, gas-turbine peak shaving, combined cycles, and automatic operation contribute to further fossil-fuel economies

■ None of the new energy sources or exotic conversion methods is ready yet to help electric utilities build capacity for the current decade. So, with over 150,000 Mw of generating facilities to build—mostly fossil-fuel-fired steam—they and the manufacturers will strive for further improvements in designs that are already commendably close to theoretical limits.

Many decades of research and development are incorporated in today's large steam turbines. Metallurgical research, by improving the thermal properties of blades, rotors, and casings, has enabled designers to raise inlet steam temperatures about 12F per year to 1,150F for the supercritical unit operating at Philo Plant and to 1,200F for the unit under test at Eddystone. Each 12F increment gained possibly 0.25% in efficiency in return for more extensive use of costly alloys.

Temperature increments have been matched by pressure increases of about 6% per year to the 4,500 psi of Philo and 5,000 psi of Eddystone. These advances, with 2 to 3% gain from the second reheat justified by supercritical throttle steam, have sustained a continuous improvement of nearly 1% per year in best-unit thermal efficiency.

Aim Is 45% Efficiency at 1,400 F

Prudence and economy have held most recent units to somewhat more conservative steam conditions. Preference today seems to focus on subcritical steam at 2,400 psi, 1,050F for units in the 200-to-400-Mw range, reserving the supercritical 3,500 psi 1,050F for units over 400 Mw. R&D teams are testing new ferritic alloys containing less chromium and other additives than today's austenitic steels, and steam cooling, to gain economy at 1,100 to 1,150F. But turbine engineers dream of 7,500 Btu/kwhr, or 45% overall thermal efficiency; to attain this they will have to use austenitic materials extensively, including one as yet called "X", for steam at 1,400F. High cost bars use of materials like the chrome-nickel-cobalt alloys which tolerate 1,450F in gas turbines, because the steam plant would require large quantities.

Temperature problems are, if anything, more acute in power plant boilers. Here, particularly in superheater tubing, metal temperatures run 50 to 150 above steam. A test set up by an ASME committee at AEP Co's Sporn Plant has 1-in. ID tubes of several ferritic alloys under test at 1,100 and 1,200F and similar austenitic tubes at 1,200, 1,350, and 1,500F. Early results have verified the scale resistance of chromium-bearing ferritic steels and revealed marked absorption of nitrogen by austenitic tubes at 1,500F.

Meanwhile appreciable gains in plant efficiency are possible from skillful study of steam cycles. Development of digital computer programs facilitates study of a sufficient number of variations to optimize the heat balance of each unit. And more refined analysis of steam flow through the turbine has brought more efficient blading and casings.

R&D in the gas turbine field will soon be evaluated in Philadelphia Electric Co's peak-shaving tests of two remotely-controlled, 20- to 27-Mw, automatic installations. Westinghouse and General Electric Co, having demonstrated the high reliability of gas turbines in ship propulsion and isolated power applications, will pit them against the economical power cost of a large utility. Basic philosophy is that gas-turbine plants for peaking service can be built for $110 to $120 per kw, considerably below steam plant costs, saving more than enough in carrying charges to cover the excess cost of their distillate fuel. Gas turbine efficiency will be improved by raising the input temperature to 1,450F for peaking service.

Gas Turbines Improve Steam Heat Rate

Gas turbines also figure in several proposals for boosting the thermal efficiency of steam plants. The preferred plan would burn the fuel in a boiler pressurized to about 90 psi by the compressor, then expand the combustion products in a gas turbine which drives the compressor and a generator. Such a combination would generate 15% more electricity than the steam unit alone with a 4 to 8% gain in the overall thermal efficiency. An alternative plan contemplates exhausting the gas turbine into the steam boiler's firebox in lieu of preheated combustion air; this method could boost steam output as much as 10%, provided the steam turbine could absorb the additional steam, while adding 15% to the unit's capability with the gas-turbine's generator.

Barrier to wider use of the gas turbine has been its inability to burn coal, the most common utility fuel. Bituminous Coal Research Inc worked for years on this application but encountered difficulty in removing ash from combustion gases. But their work did reveal new knowledge of pulverized-coal firing and flyash erosion. Westinghouse believes it feasible now to build a gas turbine which will resist flyash erosion, has offered to collaborate with a utility and a boiler manufacturer in a 50-Mw coal-fired-gas-turbine plant.

Coal Gasification Yields G-T Fuel

The other approach is to gasify the coal before firing, consuming the coal gas in the gas turbine and the coal residue, or char, in the steam boiler. This plan requires research in gasifying coal at 105 psi, which will be initiated by American Electric Power Co and General Electric Co in a 5-Mw gas-turbine installation at Muskingum River Plant. Successful application of this system to Breed Plant's 450-Mw supercritical unit could boost its net output to 500 Mw plus 71 Mw of gas turbine generation, for a combined heat rate 3.8% better than the steam unit alone.

Stack emission has long been a subject for study.

Continued R&D

But the sweeping epidemic of air pollution laws and unprecedented Los Angeles smogs have made it a prime R&D subject. The smogs were particularly significant as Southern California plants burn oil, generally believed to be emission free. So, probably for the first time, it became apparent that utilities were faced with a problem far more involved than merely collecting flyash. At this point, the Association of Edison Illuminating Cos and Edison Electric Institute joined forces with Bituminous Coal Research Inc in a major attack on sulfur dioxide and other contaminants in flue gases.

This R&D project may develop a process for catalyzing sulfur dioxide to the trioxide which can then be collected for sale as sulfuric acid. Proceeds from selling this byproduct would help to defray the expense of removing sulfur dioxide from flue gas. It also aims to develop methods for removing sulfur from steam coals prior to burning.

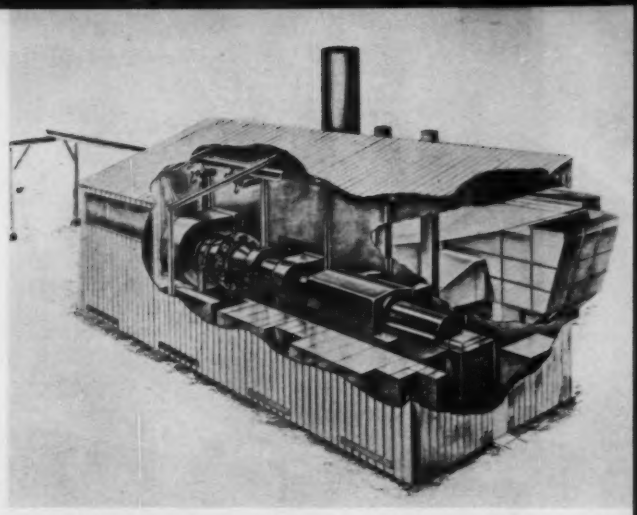
Meanwhile the suppression of flyash has become an engineering problem, applying R&D already available. One of the latest applications has been to Pennsylvania Electric Co's Seward Station where the combination of electrostatic and mechanical precipitators achieved better than 98.5% efficiency. Jet nozzles devised for the stacks in collaboration with University of Michigan, after model tests, project the remaining emission high into mountain-top air currents.

A rotary internal-combustion engine with but two moving parts, jointly developed by Curtiss-Wright Corp and NSU Werke, may lead to economies in power production. Trochoidal rotation of a rotor inside the engine's chamber first draws in the charge, then compresses it for firing under a spark plug. The exploding gas drives the rotor around until it uncovers the exhaust port. Initial production in sizes to 700 hp would be largely for transportation and portable power equipment. But later extension to 5,000 hp could make an efficient prime mover for isolated plants.

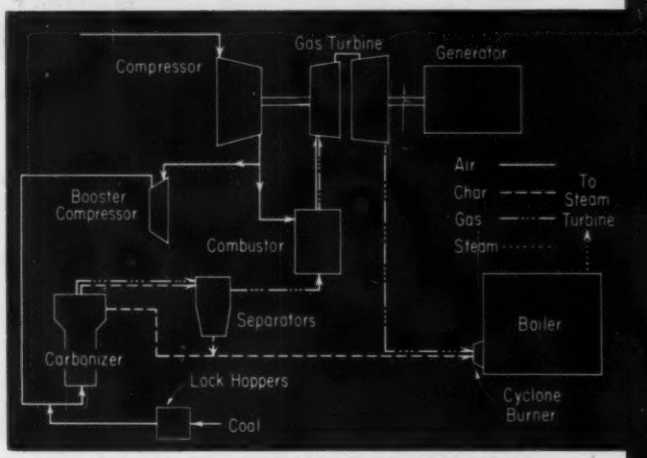
Full-Automatic Station Coming

Ultimate objective of several R&D teams is the complete automation of fuel-fired power stations to obtain optimum operating economy and reliable protection. This will require intensive analysis of functions performed today by skilled operators to reduce them to the capability of control devices. It will need dependable flame monitors and many other sensing devices. For coal-burning stations, it will require automatic coal transport from car or barge to the boiler, measuring Btu enroute to set the incremental fuel rate.

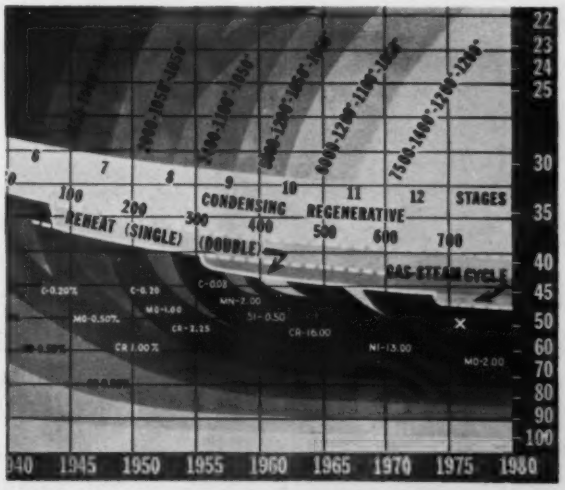
Automatic data logging, as at Gulf States' Neches Station, Louisiana P&L's Sterlington, and BC Power Commission's Chemainus, was a step toward this goal. So, too, will be the "automation" of Southern California Edison's Huntington Beach units and Louisiana P&L's Little Gypsy. These installations will push power plant control much closer to complete automation. And when it becomes complete, utilities will set new records for fuel economy and protection.



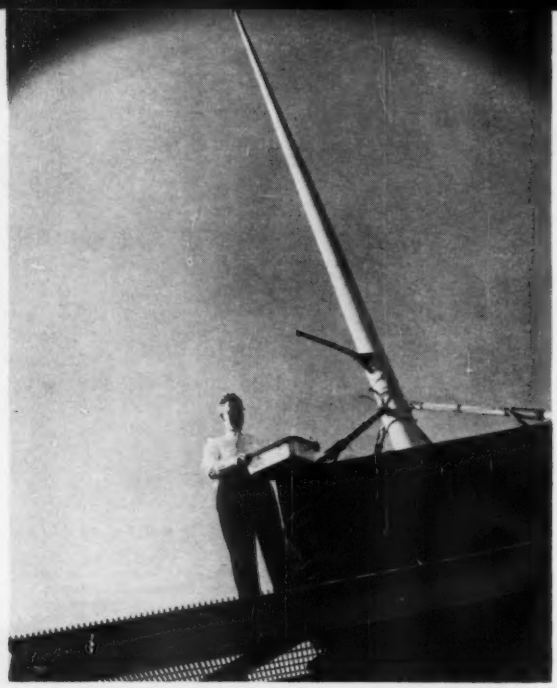
GAS-TURBINE PEAKING PLANT offers 20 to 27 Mw for peak shaving with remote starting and automatic control



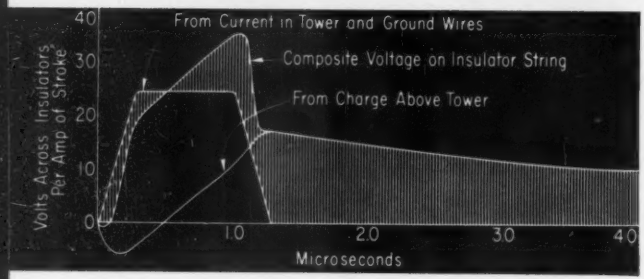
COAL PROVIDES GAS-TURBINE FUEL in system including pressure gasifier. Residual char is burned in boiler



STEAM-PLANT EFFICIENCY trends to 45%. Curve's lower edge shows best combination of bleed points, reheats, and gas-steam cycle. Numbers show unit Mw

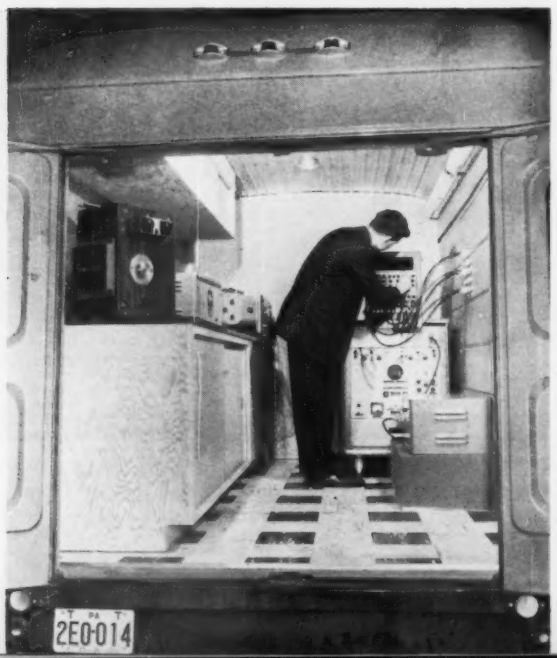


LIGHTNING'S AUTOGRAPH IS SOUGHT on records at Univ. of Pittsburgh's Cathedral of Learning observatory



CALCULATED INSULATOR VOLTAGE for stroke to tower is boosted (shaded area) by including the cloud's charge

TRAILER LABORATORIES seek switching-surge records in a new Westinghouse-AEPCo program of field tests



R&D

Transmission

Growing size of power blocks and scarcity of available rights of way speed higher voltage R&D

■ Transmission for the future must have capacity to handle the output of 500-Mw and larger generating units on rights of way restricted by population growth. Even for distances as short as 50 miles, EHV will in many cases provide the cheapest transmission of large blocks of power. And its high surge-impedance-loading rating makes it more attractive for longer distances.

These factors have spurred EHV research. Utility engineers, manufacturers, professors, and consultants have joined forces to explore its parameters and establish factors for future designs. Among the objectives of this R&D are:

1. Evaluating and devising techniques for suppressing radio interference and corona.

2. Clarifying lightning theory so EHV lines can be built for prescribed reliability without uneconomic expenditure for insulation or protection.

3. Establishing the magnitude of switching surges and methods for controlling them.

4. Improving damping methods for vibration so spans can use more of conductors' inherent strength.

5. Extending knowledge of "galloping" so lines can be built to resist it.

Tests on several operating 345-kv lines by General Electric Co and utility engineers have established the parameters of radio noise to such a degree that it is believed possible to calculate the performance of any proposed line. Efforts are now directed toward evaluating bundled vs single conductors, also the stress concentrations near supporting structures, looking toward selection of the most economical conductor for future EHV lines.

Interruptions from lightning greatly in excess of specifications for American Electric Power Co's 345-kv lines revealed shortcomings in the "AIEE Method." R&D in this area has followed two paths, one a critical review of lightning stroke theory, and the other an intensive drive for new field data on lightning discharges.

Analysis Boosts Voltage Estimates

Review of lightning theory by Westinghouse engineers has disclosed that (1) the impedance to ground of high towers is somewhat greater than had been assumed for calculations and (2) the conventional method of computing lightning voltages on insulation neglects the effect of the cloud. Correcting the tower impedance boosts calculated voltage 25% or more. But the return stroke can, under certain conditions, dominate voltage distribution on the line and contribute a peak well above voltage calculated by conventional methods.

They have also hypothesized a release of energy from the lightning stroke's leader, a sharp spike of current at the initiation of the main discharge. Trapping

Stresses EHV Line and Cable Projects

for confirmation of this new concept will start soon with a batterry of klydonographs specially rigged to record the fronts of travelling waves.

Meanwhile a General Electric team has sought to simulate strokes to tower lines by flashing a suspended electrode to a scale-model tower and, collaborating with Detroit Edison Co and AEP Co, by discharging a small surge generator set atop a 345-kv double-circuit tower into a wire between the tower and a balloon 400 ft above it. Such tests have verified methods of predicting insulator voltages for any tower-current wave, and spurred efforts to collect better records of lightning stroke magnitude and wave shape with new instruments on ten miles of AEP Co line. The first season produced three records.

A powerful tool for lightning research has been Westinghouse's test station on University of Pittsburgh's 545-ft Cathedral of Learning. A ball-topped aluminum pole, projecting 50 ft above an insulated platform, probes for lightning which it is prepared to record with three wave-front klydonographs and a cathode-ray oscilloscope.

Investigations Seek Reduced BIL

Lightning investigations take a different turn in transmission substations. Here the objective is to control travelling waves from incoming lines so reduced-BIL insulation may be specified for transformers and switchgear. Savings in this area have already contributed considerably toward making EHV feasible. Additional savings may come from use of reduced-voltage arresters installed in accordance with transient analyzer data, provided recognition can be devised for irregular impulses from steep-front and chopped waves.

Switching surges today hold the key to further EHV economy. Accordingly R&D will be pushed with two mobile laboratories which took the road last month in a joint AEP-Westinghouse survey of switching surges on lines and stations up to 345 kv. Westinghouse plans, through an extended series of tests, to develop a digital computer program for switching surges. Already they have found that a breaker can clear more capacitance in 138-kv cable than in capacitor banks, that opening a bus disconnect can cause voltage doubling and widespread arrester operations, and that a 230-kv breaker operation can flash transformer arresters 70 miles away.

General Electric Co contends that the ability of modern circuit breakers, both oil and air-blast, to suppress re-strikes has essentially overcome the line-dropping surge. This leaves such other criteria as (1) the energizing surge of a transformer-terminated circuit and (2) the surge when load is dropped on the low side of the transformer. The first can produce a 3-per-unit transient when switch poles close sequentially. The second, by suddenly unloading transformer and line, causes enough voltage rise to over-excite and partially saturate the transformer, causing harmonics which resonate with source impedance and line capacitance to a critical voltage level.

The potential gain in system stability from rapid reclosing of a line section focuses critical attention on the lack of specific knowledge of EHV arc deionization. This is the R&D subject of an AEP-General Electric team which, after 345-kv field tests to 40,000 amp asymmetrical, has cut reclosing times to 22 cyc for much of AEP's 345-kv system. Recognizing the possibility for error in tests initiated with fuse wire, this group plans a high-power laboratory test with faults initiated by a surge generator.

Conductor Vibration Studied

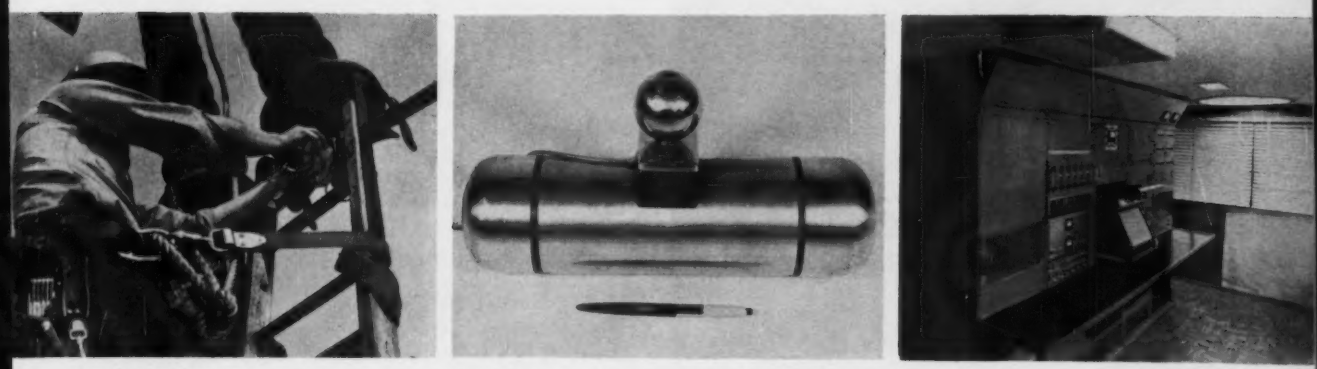
Conductor vibration remains an R&D problem. Objectives are to cut maintenance requirements for conventional lines and to gain economy by using high-strength conductors at higher tensions. R&D in this area has these three objectives:

1. Clarifying the aerodynamic mechanism which causes vibration.

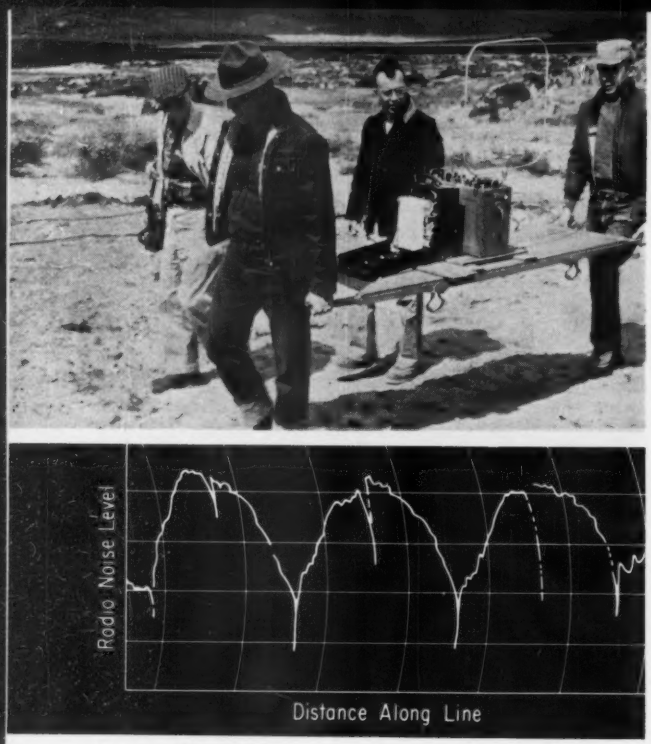
2. Evaluating the conversion of vibration to stresses in a conductor.

3. Determining the fatigue limits for conductors subjected to composite stresses.

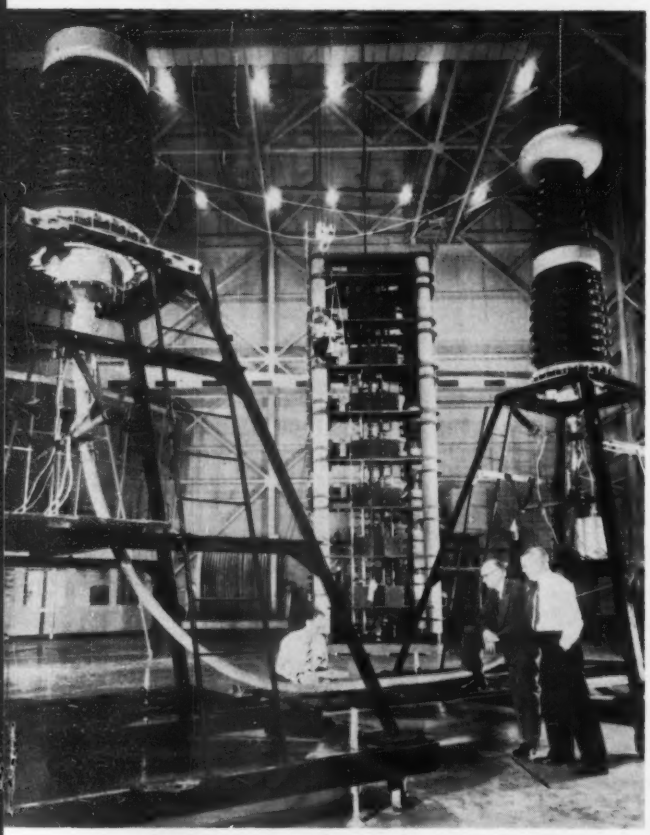
Vibration data are being recorded on energized lines



DETECTOR ON LINE (left) senses stresses, puts signal into FM transmitter (center) for safe relay from energized line to recorders in Preformed Line Products Co's trailer (right) or in jeep (not shown) used for rough terrain



FIELD STRENGTHS measured by stretcher-mounted instruments (photo) establish standing-wave pattern of radio noise along the Leadville high-altitude test line (chart)



TERMINALS FOR 345-KV CABLE are installed for 60-cps potential and surge tests in new Anaconda laboratory

by Preformed Line Products Co, in collaboration with numerous utilities, with two mobile laboratories and an extensive recording program. First of these was the Dynalab; this provides strain gauges to measure individual strand stresses as well as total tension, accelerometers to measure conductor movement, thermistors to sense conductor and air temperatures, and a complement of weather recorders. All signals are wired through amplifiers to various indicators and a 36-channel oscillograph. Sensing devices on energized conductors can be linked to recording equipment via short-range FM radio.

A small version of the Dynalab, in a Jeep for use in less accessible locations, provides two radio channels for signals from sensing devices on energized conductors, and a few aerodynamic recorders.

Meanwhile Aluminum Co of America continues its search for new conductors of greater strength or conductivity, checking them on several atmospheric test racks and in the laboratory. Vibration and its control are checked on indoor spans. And creep data are collected to aid utilities in designing and building lines.

Galloping—the violent oscillations which sometimes beset line conductors under certain ice and wind conditions, causing them to whip or to damage supporting structures—is scheduled for intensive R&D. Plans of a group of utilities and manufacturers contemplate aerodynamic testing and analysis at Massachusetts Institute of Technology.

EHV Projects Push Voltage Higher

Testing will start next month at 460 kv on part of Project EHV—thereby setting a new voltage level in the U. S. The R&D team assembled by General Electric Co for this project includes representatives of 15 utilities, six equipment suppliers, and 12 consultants.

The test line will be 4.3 miles long, arranged to tie at both ends to 115-kv transmission so it can carry load. The project will include a variety of structures, conductors, and configurations. It will be tested first at 460-kv, 3 phase, then converted to 650 kv and operated as part of Western Massachusetts Electric Co's system. Measurements will include lightning, radio noise, weather, corona losses, and other pertinent data.

Another EHV project announced late last month will test line configurations for radio influence and corona losses at 750-kv. This program, scheduled to be energized by year's end, will be a joint venture of AEP Service Corp and Westinghouse, with assistance from five other manufacturers. It is planned with three half-mile test lines at Apple Grove, W. Va., to extend R&D begun at Tidd Plant in 1946.

Meanwhile Pennsylvania Electric Co and collaborating manufacturers are pushing ahead on a 13-mile 460-kv line. Designed to become, after tests, part of Penelec's transmission network, its sponsors hope it will establish design parameters for a new Pennsylvania-New Jersey EHV link.

North of the border, Ontario Hydro engineers are approaching the end of a year's tests on a 4-conductor-bundle 460-kv test line at Coldwater. Information from these tests will be applied to the contemplated transmission of 1,000 Mw from near James Bay to the mining area 270 miles south.

High-altitude tests by Public Service Co of Colorado

and a group of manufacturers at Leadville have amassed data to evaluate the effect of altitude on corona loss and radio interference up to 460 kv. Discovery of the standing-wave pattern of noise along the test line is expected to help in extrapolating data to longer lines.

EHV has spurred new R&D on structures, reflecting the possibility that its larger conductors and greater phase spacings might call for new solutions. Thus Project EHV will have an assortment of steel, aluminum, and laminated wood structures. Penelec's line will also have experimental structures but will depend on 4-pole frames for most of its 93 locations.

EHV-Cable Tests Seek Better Insulation

Traditionally, cable development has lagged open-wire by nearly two decades, although the Swedes used a short section of 425-kv cable in the world's first 425-kv transmission. Although U. S. utilities have held their cable at 230 kv and below, with less than two miles at 230 kv, several have indicated a need within the decade for cable to carry 500 Mw or more per circuit at voltages up to 345 kv.

Thus the electrical industry faces an urgent need for insulating materials that will extend power cable capabilities beyond present thermal barriers. It must find a solution to the dielectric losses and charging current which today impose severe limitations on permissible cable lengths. To this end, it has contributed money, manpower, and material to a three-year testing project sponsored by AEIC and EEI at Cornell University.

Early this summer, four lengths of 345-kv cable, complete with joints and terminals, will be energized in a series of tests to evaluate their suitability for utility use. Two are in place; Okonite's 2,000-MCM segmented, sector-type in a high-pressure pipe; and Phelps Dodge's 2,000-MCM compact-segmented, hollow-core, paper-insulated, aluminum-sheath cable for a 200-psi oil-filled system. General Cable plans to provide another pipe-type design; and Anaconda, a low-pressure oil-filled, paper-insulated cable with lead sheath.

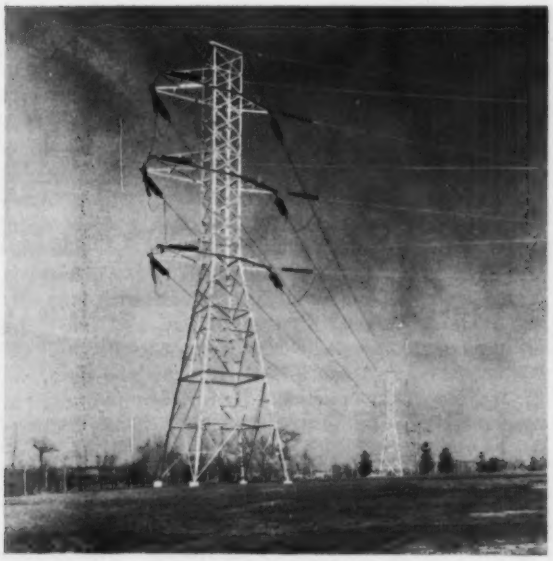
Cable manufacturers are already supplementing the Cornell tests with some of their own, the most recent being Anaconda's in a new $1¾-million research laboratory. Facilities include a 3,000-kv high-capacity impulse generator; three 150-kva 250-kv transformers which may be cascaded for 750-kv tests; a cable tunnel for six 150-ft lengths of cable; and a 500-amp insulated germanium rectifier for cyclic current tests.

Study Dc Transmission for EHV Links

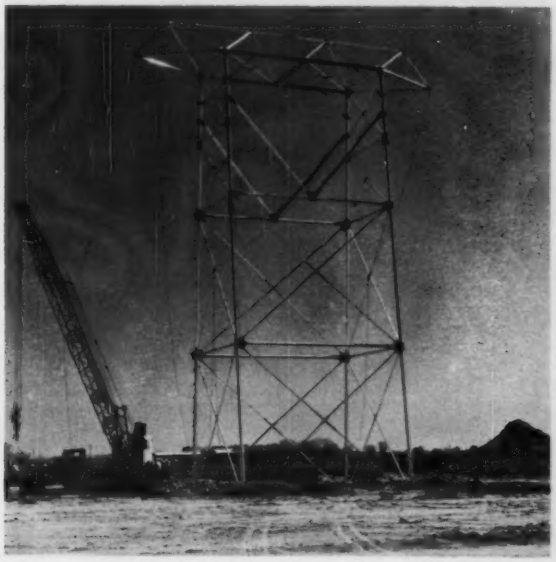
Dc transmission has been proposed to avoid dielectric losses, charging current, and length limitations of high-capacity ac cables. Proponents cite the working 100-kv Sweden-Gotland link and plans to link the British and French systems via dc cable under the Straits of Dover. General Electric Co analyses, for a 500-Mw circuit between generator terminals and a 138-kv system, show dc cable cheaper than ac but offset by conversion costs for distances under 40 miles.

Meanwhile, Philadelphia Electric Co, anticipating that dc links may become necessary in its expansion, is testing a 50-kw model. Terminal equipments are modified dc-motor drives, each including six grid-controlled, mercury-arc tubes. This model has operated as a dc link between two ac systems, and as a dc feed to isolated ac load. Output frequency in both cases was controlled by grid pulses and reactive, supplied by capacitors. These tests reveal need for R&D to overcome heavy harmonics in both dc and ac lines, to determine response to faults and load changes, and to correct reactive requirements by forced commutation.

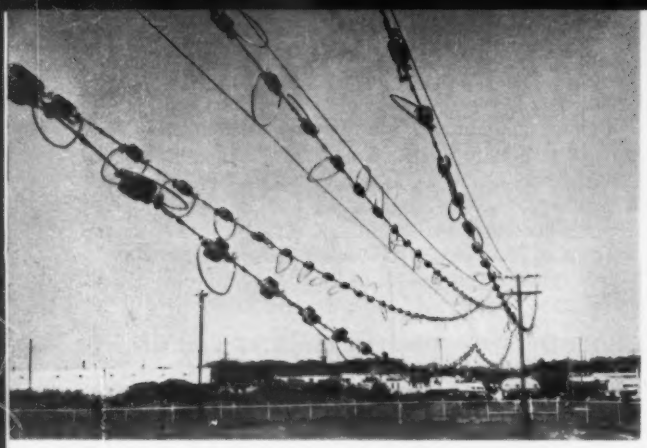
Industrial engineers are quick to observe that the mercury-arc frequency converters used for over 15 years in U. S. Steel Corp installations near Pittsburgh and Gary have the elements of dc transmission. They step down and rectify the incoming 60-cps ac to about 12.5-kv dc, then invert it to ac at 25 cps. Tubes are available today, they say, for 100-kv dc.



STRUCTURAL ALUMINUM TOWERS get field test on Philadelphia Electric 230-kv line (photo courtesy of Alcoa)



TUBULAR MEMBERS feature aluminum tower proposed by Reynolds Metals Co for an Arizona 345-kv line



R&D

Distribution

Insulation, corrosion control, timber preservation, tree growth, noise linked in far-flung attack

CORROSION RACK on Texas Coast tests joints on aluminum conductors exposed to saline atmosphere, seeks dependable methods for making connections on weathered surfaces

■ Distribution has its research and development too, making up in variety and quantity for its lack of MHD or EHV glamor. For distribution must go where customers want electricity—not on sites and rights-of-way selected for convenience and desirability.

Covered wire, used extensively for secondary and service conductors, has benefited from chemical manufacturers' R&D which brought high-density polyethylene into prominence. Extensive research has given it toughness, high abrasion resistance, and freedom from cracking and embrittlement.

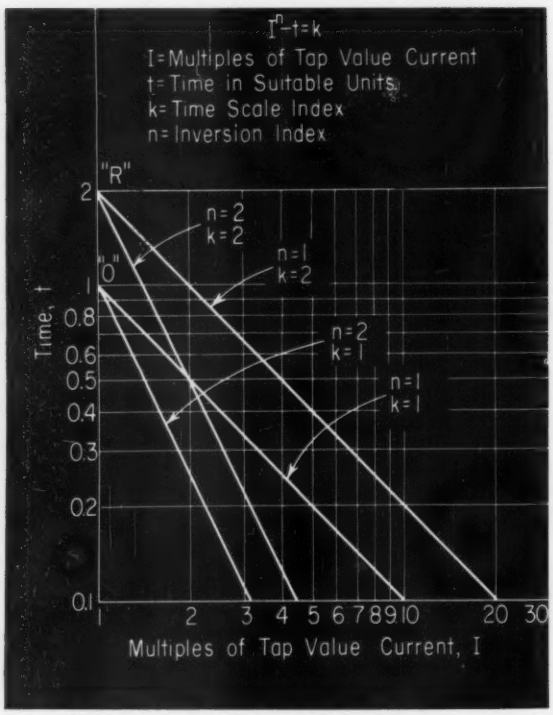
Racks Test Corrosion Effects

In aerial cable and tree wire, this and other synthetic insulations are helping utilities to maintain distribution service in heavily-treed areas, despite wind and ice storms. Research by one Eastern utility has brought costs for storm-resistant 4-kv plant to within 3% that of previous open wire. Today it is applying similar techniques to 13-kv, hoping to match the reliability of the 4-kv system.

With such varied exposure, it is not surprising that corrosion is a major area of R&D. Test racks are kept under surveillance at Hawaii, on the California Coast, and at several other locations where atmospheric contamination is extreme.

One of these, maintained by Central P&L Co and Burndy Corp at Aransas Pass on the Texas coast, is designed to check the effect of humid, saline atmosphere on aluminum conductors and joints. It includes numerous loops in the originally continuous span wires, so arranged that some can be cut and replaced each year with by-passes to test the efficiency of new connections made by different procedures on weathered aluminum conductors. The test spans are given 2-hr periods at 200 amp every day and joint resistances are measured periodically. Preliminary results indicate that compression connections perform "slightly better" than bolted ones and that "laboratory clean" joints out-perform others.

Other tests by Aluminum Co of America, Kaiser, and Preformed Line Products Co simulate the Aeolian vibration which constantly threatens aerial spans with fatigue failure, chafed tie wires, and loosened connections. Various corrective procedures are under study.



STATIC RELAYS offer new flexibility in time-current characteristics to match protection and coordination needs

Chemical Tests Seek Savings

Untold millions of wood poles support the nation's distribution circuits. Detroit Edison Co, recognizing that replacement of its poles would cost over $35 million, is collaborating with the University of Michigan in a program to establish methods for extending pole life.

Traditional hazard for distribution, and for many utilities the greatest single cause of service interruptions, has been trees growing under and near pole lines. So the industry, after many decades of costly pruning, has undertaken a radically new approach. It has commissioned Battelle Memorial Institute to study the physiology of tree growth and seek a chemical which can be applied to regulate it. Sample plantings of trees are under observation today.

Chemists and ecologists have joined forces in another attack on trees—this one to secure more effective control of growth on rights-of-way. Dry pellets of a

Gains from R&D in Numerous Fields

new formulation applied to several test tracts on the New England Electric System early in 1956 show an increasingly complete "kill" of oaks, birches, maples—some 20 species in all. The timber has been replaced by a natural growth of low ground cover.

Field testing with a mobile laboratory helps S&C Electric Co to track down the voltage recovery characteristics of distribution circuits. Such tests are expected to establish the range of conditions which interrupting devices encounter in service.

Static Relaying Is R&D Dividend

Earlier R&D established the clearing time-current characteristics needed in distribution circuit protection. More recent work, aided by adaptation of static devices from the communication and industrial control fields, has given Allis-Chalmers Mfg Co a pulse discriminator capable of detecting fault magnitude with 10% accuracy in the first 250 Msec. Used to trip a 2-cycle breaker, it promises to clear distribution faults before conductors are burned.

Other applications of static devices to relays hold promise of a whole new family of operating characteristics to improve the protection of all segments of utility systems. Complete replacement of all moving parts by semi-conductors, resistors, capacitors, and transformers —all perfected by R&D in communications laboratories—gives designers new freedom in matching protective relays to circuits and apparatus. Trial application as phase comparison relays linked via carrier on an AEP Co 345-kv circuit has shown them capable of expansion to more complex transmission systems.

R&D is still in order for static relaying. Existing transistors are vulnerable to surges in dc and ac inputs and to ground potential during a fault. Improvements are needed to overcome the 50C limitation of germanium components. But static relaying is about ready for general use.

Noise Tests Ease Site Problems

Transformer noise has become a critical consideration in securing substation sites. Accordingly, extensive R&D has been directed toward finding acceptable solutions. This effort has sought (1) to determine the causes of noise and methods for controlling it, and (2) to determine what noise levels are tolerable and how site modifications can win acceptance for transformers.

Recognizing that magnetostriction in core steel causes 85% of transformer noise, Allis-Chalmers joined Crucible Steel Co in developing new steels which will cut both noise and core losses. Meanwhile test equipment in a mobile laboratory helps to evaluate baffle configurations at A-C's Carrollville test site as well as at several utility substations. And a number of utilities, including United Illuminating Co, have incorporated noise absorption into standard designs for distribution substations.

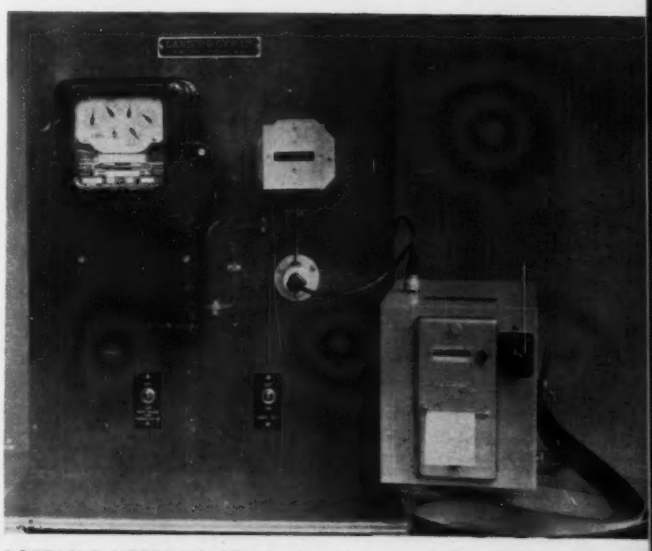
An alternative to noise suppression is to surround the transformer, except its radiators, with an aphonic enclosure. General Electric Co, after testing the concept on a distribution substation transformer made for Niagara-Mohawk Power Corp, has applied it to cut noise 23 db on a 208-Mva phase-shifting transformer for Consolidated Edison Co's Hudson Avenue Station.

Push Toward Remote Meter Reading

Automatic meter reading is a long-standing dream of meter engineers. But their efforts have been thwarted by inability to develop a cost per meter lower than the meter reader with his book. A step in this direction is seen in Landis & Gyr Ltd's counter for reading inaccessible inside meters through a receptacle outside the building.

Telephone lines provide the link for remote reading of customer meters in two proposed systems. First of these is North Shore Gas Co's plan for monitoring daily consumption of 60 large customers who can be asked to curtail use during gas shortage periods. This system contemplates a $250 "readout" unit at headquarters which can be dialed to cause a $350 carrier device at the meter to pulse its reading to the "readout" unit via telephone circuits. Another proposal is to count pulses stored on the meter register by a direct telephone connection.

Metering, too, is feeling the impact of semiconductor R&D. For, with the development of indium-arsenide, the Hall effect, discovered in 1879, became a practical method for multiplying volts and current in a wattmeter. The system functions by magnetizing a wafer of In-As with the field set up by load current in a coil, impressing a portion of ac line voltage on one axis to excite the wafer, and taking off dc volts on the other axis to a millivoltmeter calibrated in kw, a telemetering transmitter, control device, or recorder. The Hall element holds promise in static relaying, too, as the differential between its output and that of a square-law voltage rectifier responds to faults like an induction relay.



PORTABLE METER READER (right) plugs in to "read" the register of an inaccessible indoor kwhr meter

R&D

Digital Computers Speed Research in

New programs make machines do step-by-step calculations to cost system growth, check its capability

■ Digital computers have become a powerful tool for research and development, particularly where volumes of data must be analyzed or solutions found for complex equations. According to a recent National Bureau of Standards report:

"The use of automatic computation as an aid in research is . . . becoming the rule . . . Large-scale digital computers help the Bureau to carry out its fundamental program . . . with increasing speed, efficiency, and thoroughness."

Utility system planning is an area where digital computers are used to full advantage. They enable planners to apply the full potential of statistical methods and probability to a degree never before possible. Such thoroughness in planning promises smart system expansion.

Computer Programs Plan Growth

The programs by which computers are directed to 'think" on engineering problems are a major R&D contribution. An outstanding example is the method developed by a task force from Westinghouse and Public Service E&G Co to determine the best pattern for system additions to serve predicted loads. These engineers, using new techniques and a high-speed digital computer, created a mathematical model of the power system. With it they are studying spinning reserves, worth of lower heat rates, dates for generation additions, maintenance schedules, retirement of old generators, and the value of improved reliability.

The model responds to the same factors and produces the same results as the actual power system, because its equations describe the system's behavior. Some equations represent relationships between variables. Others describe logic, similar to that of system operators, which the model uses to make operating decisions. These equations are placed in the computer along with data describing load trends, unit outage rates, probabilities of error in load forecasts, and other indices.

Model Simulates Day-by-day Operation

In the computer, the model simulates future day-by-day operation of the utility system. It estimates what units must be operated to supply the peak load, simulates their startups, plans their maintenance, and accepts forced outages. From this simulated experience, the model determines the margins of available capacity above peak load and uses them to determine the monthly risk of shortage. When the risk exceeds a preselected level, the model adds the next unit from a pattern supplied as input data, thus developing a schedule for generation additions giving size, location, type, reliability requirements, and heat rate for each. In the process, it calculates monthly production costs and revenue requirements, covering 20 years of growth in about 20 min.

The daily peak load pattern, developed statistically from historical data, reflects the probability of boom and recession years as well as the random effects of weather. This random variation within a preassigned pattern recognizes that, while the overall pattern of future loads is known, their exact sequential values are not. A similar treatment reflects forced outages and errors in forecasting future loads and conditions.

Because of this random variation, one 20-year simulation represents only one of many possible ways in which the future might unfold. Accordingly, the model runs additional 20-year simulations, each with different

Operation Seeks Gains in Automation

Computers and electronic devices give data to schedule generation, prepare for weather changes

■ Operation requires prompt and accurate determination of system switching and generation scheduling to serve changing loads with optimum economy and adequate reliability. Research and development in this area, begun before the advent of digital computers, quickly seized upon them to gain speed and accuracy.

Computers were used initially only to determine indexes for operators to set into operating instructions. But several automatic load-control systems today have computers which analyze system conditions and automatically correct index settings. R&D continues in this area, seeking to devise the best computer-controlled, automatic system for complex, expanding power networks.

Control of steam systems is customarily based upon incremental power cost, largely fuel modified by heat rate. But control of hydro systems must be based upon river flows, water in storage, and expected rainfall, none of which apply to steam plants. Thus, for a system with both hydro and steam generation, automatic control lacks a common denominator. This subject is under R&D in several utilities, and General Electric Co has contributed mathematical concepts and equipment. The final method remains to be developed, but computers will certainly be involved.

Meanwhile, improved systems are giving operators better information. Idaho Power Co uses closed-circuit TV to relay remote kwhr readings to dispatchers' con-

Planning Utility System Expansion

random numbers, until enough are available for valid conclusions about the probabilities of future occurrences.

Another part of the model plans and costs the transmission to connect added generation to load. It adds the present worth of these costs, the revenue requirements of production costs, and generator capital costs to give the present worth of revenue requirements for the expansion pattern. By repeating this procedure for each feasible pattern, it indicates which one offers the lowest cost.

Any desired number of variables can be incorporated in this simulation. The effect of even the smallest variable can then be studied. Thus, as the model is re-run with new data, management has complete cost information for the system.

Program Predicts Future Generation Cost

A program based upon different mathematical disciplines has been developed by General Electric Co for predicting accurately the total system costs of future generation plans. Important aspects are:

1. Units are scheduled on an equal incremental cost basis.
2. Chronological variations of hourly load are accurately represented.
3. Load cycle is continuously modified to recognize daily, seasonal, and long-term trends.
4. Units are started and stopped according to spinning reserve requirements.
5. Maintenance done on constant-risk plan.
6. Effects of inflation are considered.

Generation planning has taken on new variables. Sustained rapid growth has put many utility systems in the position where most of their generation is in modern units. Thus they stand to gain little by adding more efficient units and relegating capacity only ten years old to low-load-factor operation. The alternative is to build for economical low-load-factor operation, and recent developments have come up with several possibilities. Among them are:

1. Pumped hydro
2. Automatic diesel plants
3. Automatic gas-turbine plants
4. Steam units designed for peaking.

These alternatives involve wide variations in investment costs, fuel costs, and capabilities. Selection of the best for any system calls for painstaking analyses, and sometimes computer programs are advisable to get optimum solutions.

Other programs analyze load flows in today's far-flung interconnections. One of the newest, developed by American Electric Power Co, permits study of load distribution in its own 5.6-million-kw system and major interconnections between Chicago and Atlanta. Even the step-by-step analyses of system stability and protection are done by computers, making them a major tool for system R&D.

Planning Cuts Distribution Costs

Distribution likewise involves many variables and—for the utility—random load patterns. It is further complicated by the permanence of its assocation with the utility's load area and the high cost of changing it once it goes in service.

Early computers, which served well for bulk-power analyses, lacked the memory capacity to plan distribution. But with the advent of today's giant computers, many utility engineers are using them to re-evaluate distribution practices. New knowledge from these analyses will enable distribution engineers to plan future additions for optimum economy and adequate service quality.

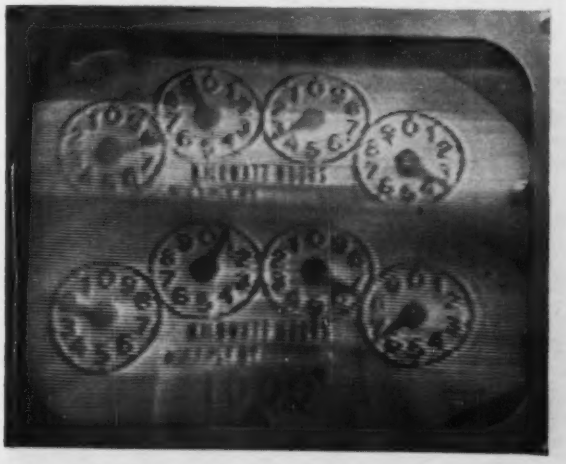
and Meteorology

soles. Arizona Public Service pulses interconnection-point readings directly to its computer for analysis. The water content of snow in river headwaters, important to hydroelectric plant operators, is measured by its absorption of radiation from buried cobalt-60 and microwaved automatically to the U. S. Corps of Engineers at Sacramento, Calif., and Walla Walla, Wash.

Weather affects operations in at least three ways:

1. Prolonged heat in summer and cold in winter cause load peaks which require capacity.
2. Severe storms, such as sleet, hurricanes, and lightning, threaten extensive damage and call for holding crews in readiness.
3. Rainfall represents potential energy to a hydroelectric system and, if excessive, flood damage to utility plant. Both require preparation.

For these reasons, utilities have long had an interest



KWHR READINGS at key points are continuously televised to system operator's console via microwave channels

R & D

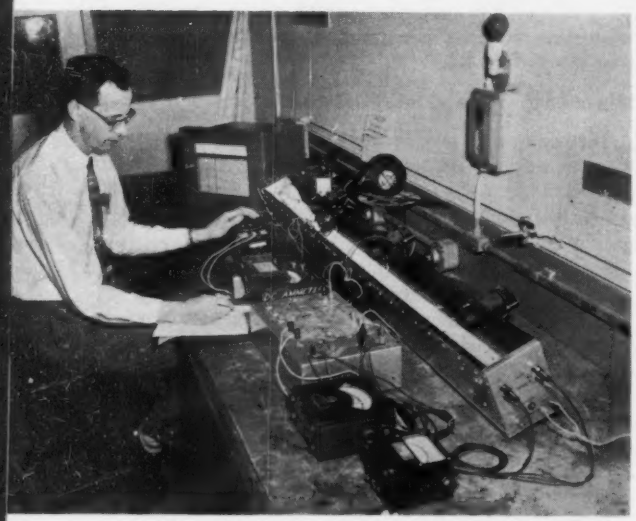
in meteorological research. The initial limitation of data to ground-level observations has been overcome by aerial probes, even into the stratosphere where harbingers of surface wind changes have been detected. Such data are today fed into computers which print out reliable short-range forecasts. Research is expected to extend the range to months and some private services already have methods for long-range forecasts.

Radar is a potential new tool for meteorologists. Already widely publicized for tracking hurricanes and tornadoes, it has demonstrated its ability to record lightning discharges. Stanford Research Institute is preparing to test it for measuring precipitation in the atmosphere, feeding data into a computer to read out rainfall anywhere within scanning range. Meanwhile, the Defense Department is testing a radio system to record lightning on a monitor map at Kansas City for the U.S. Air Force and the Weather Bureau.

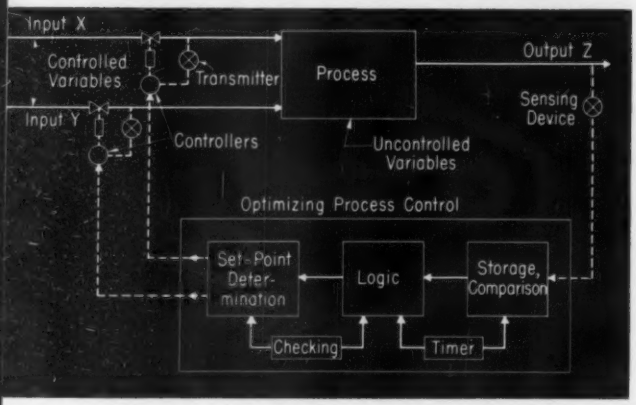
Weather has considerable effect on utility loads. Some utilities base their day-to-day forecasts upon normal trends adjusted for local weather forecasts. But Southwestern Public Service Co has developed a unique system in which forecasts are based upon the ten-year average adjusted for deviations of temperature and rainfall.

Weather modification has a special appeal to hydroelectric utilities which see in it a means to bolster stream flows during low-water periods. Shortly after General Electric Co revealed that tiny crystals of silver-iodide could "seed" clouds to start precipitation, Pacific G&E, Southern California Edison, Pacific P&L, and Washington Water Power began seeding. Evaluation of their efforts indicated a gain of over 10% in weighted average rainfall. The run-off for one area was credited with 469 million kwhr, worth $1,086,000. Seeding cost was $139,470.

The usual method of seeding is to spray silver-iodide solution into a propane flame, then quench the



LIGHT OUTPUT IS BOOSTED by thermoelectric cooling of the fluorescent lamp in a street lighting luminaire



INDUSTRIAL CONTROL, directed by semi-conductors, analyzes deviations and applies logic to make adjustments

Utility Growth

Househeating, appliances to benefit from thermoelectric research. Lighting gains from continued R&D

■ Many utilities look to electric house heating as the most promising field to cultivate for continued load growth. To them, recent advances in thermoelectricity hold particular interest, for research has come up with new semiconductors to make the long-known (1834) Peltier effect applicable to heating and cooling.

First commercial application of the Peltier effect will be to refrigeration. Developments in the last decade have boosted its cooling capability from about 20F to nearly 130F. At about 200F, only a year or two away at present rates of improvement, it could become competitive with mechanical refrigeration. Meanwhile the Peltier effect cools water flasks on executives' desks and will soon go to sea on a naval vessel in Westinghouse's combination 1-ton air conditioner, 2-cu-ft food freezer, and space heater.

Other applications in the planning stage include new bathroom heaters, water coolers, household refrigerators, and home heating and cooling. Westinghouse envisions a unit with programmed control to store and prepare meals.

Radiant Heating, Heat Pumps Gain

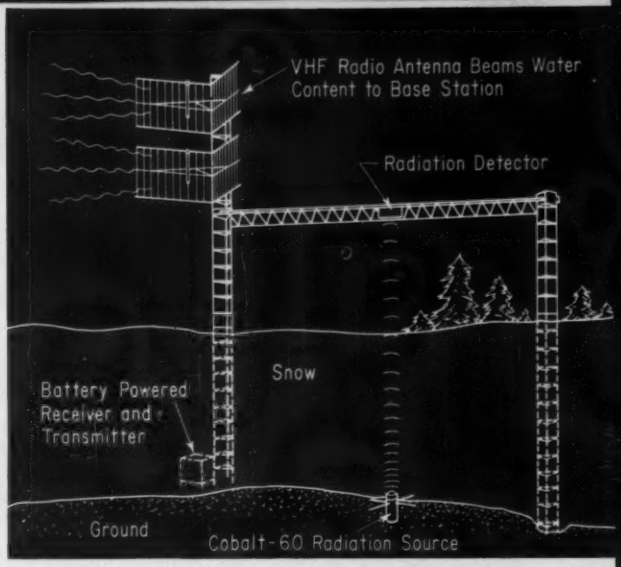
Meanwhile, radiant heating will become more attractive with electrically-warmed, laminated-plastic panels (80-100F) and baseboard strips (130-140F). Heat pumps will gain economy through the extension of R&D on heat storage systems begun by Battelle Memorial Institute and Comstock & Wescott Inc for the AEIC-EEI Heat Pump Committee.

Lighting is always a good load builder. The industry stands to gain from promotion of high-level illumina-

vapor to form crystals of about 0.01 micron. The crystals ascend slowly to a 25C level where they induce the formation of ice crystals. These grow, then fall as rain or snow.

A new target of weather modification is the glaciers of the Pacific Northwest which hold water comparable to maximum storage in the Columbia watershed. Experiments indicate that melting can be induced by dusting the glaciers with carbon or pigments to make them absorb solar heat. The increased runoff would help to relieve water shortages during summer droughts. Commerce Department R&D will determine optimum operating parameters of this method and its economic feasibility.

But meteorologists dream of bigger jobs to come. According to Admiral Luis de Florez, "It is of greater immediate importance . . . to find the answer to the feasibility and practicability of weather control than to land a man on the moon."



WATER CONTENT OF SNOWPACK is measured by its absorption of cobalt-60 radiation, radioed to base station

Gains from Bizarre Applications

tion in the home as well as at work. Lamp manufacturers have improved the phosphors and cathodes of fluorescent lamps to get quick starting and higher lumen outputs and may eventually go to color-corrected, mercury-vapor tubes. Recent R&D on static devices has produced compact frequency changers to step up the efficiency of high-level fluorescent lighting. Light outputs of fluorescent street lights will be boosted by Line Material Industries' tests on thermoelectric cooling to decrease mercury-vapor pressure.

Radiant-panel lighting has been improved by continued R&D on phosphors and excitation systems, but cannot today handle the 50 to 100 lumens per sq ft required for ceiling lighting. Its efficiency is good (15 lumens/w) and installation should not require costly fixtures. But R&D must continue through the next decade to get electroluminescent lighting ready for extensive use.

UV Lamps May Promote Health

Lamp R&D is now engaged in a curious foray into the medical field. It has been found that negative ions in air speed the healing of wounds, ease suffering of asthmatics, and possibly delay the growth of cancer. Negative ions can be produced by the same type of ultraviolet lamp that kills bacteria in a school room or butcher's beef tenderizer, if it is wrapped with silver- and gold-bearing copper gauze. Such a lamp can be placed in heating ducts, or combined with filter and fan in a small appliance for use in every room. In this form, it could become an interesting load builder.

Industrial utilization is responding to the stimulation of semi-conductor devices adapted from communication R&D. These devices offer a choice of characteristics surpassing that of vacuum tubes, and with better life and reliability. As silicon power rectifiers, they provide dc for industrial drives at up to 850 v with less than half the losses of ignitrons. With the addition of a grid or "gate," the silicon rectifier becomes a controlled device for variable-speed dc drives or, connected as an inverter, for braking mill motors by feeding their energy back into the ac supply.

Another application of semi-conductors is the control of industrial processes. Applications vary from tape control to static-device "logic" circuits which "analyze" deviations and determine corrective measures much like a human operator.

Flash Evaporator Opens New Areas

Electric utilities stand to gain from R&D in still another area—the low-temperature evaporator, which flashes high-purity water from sea water with the heat of nearly-spent steam or the effluent from a main turbine's condenser. The latest installation of this type, placed in service last month at Southern California Edison Co's Mandalay Beach Steam Plant, was designed to extract 100,000 gal of potable water per day from the Pacific Ocean. This water, expected to meet Public Health Service requirements for drinking water, will supply makeup for the station's two boilers.

The flash evaporator, as developed in Westinghouse laboratories, sprays warm saline water into a chamber held at lower temperature and pressure to extract water vapor. This vapor is condensed in another chamber and drawn off with impurities as low as 0.25 ppm. Initial installations at Kuwait, Arabia, supply 2½ million gal of drinking water per day with the heat from saturated steam at atmospheric pressure.

Thus the electrical industry enters its bid to supply water for irrigation and drinking in areas where population growth is limited by the lack of fresh water. If it succeeds, it will have a powerful tool for area development and load building in areas not suitable for such use today. Such a program, ex-President Truman recently said, could make deserts bloom and forestall all need for world-wide birth control.

R&D

Pure Research Holds Key to Future

Quest for knowledge about solids, liquids and gases will bring breakthroughs for R&D projects

■ Pure research is the reservoir out of which flow new discoveries to fill the pipe line of applied research and development and to break barriers blocking progress. Utility R&D in the next few years will benefit from pure research in:

1. Molecular electronics and semi-conductors.
2. Metals for high temperatures.
3. Cryogenics.
4. Plasma and arc interruption.
5. Electrical insulation.

Developments in molecular electronics have come in such abundance that the U. S. Air Force has begun to catalog them in what resembles the chemist's periodic table of elements. Such analysis reveals areas for continued R&D and the probable performance of new combinations.

Circuitry for molecular elements is not wiring of components but rather the rearrangement of atoms to get desired performance. The starting point, according to Westinghouse, may be a single-crystal block altered by controlled introduction of impurities. Tools are diffusion, plating, electron-beam machining, etching, cutting, radiation, alloying, and photographic processes.

Molectronics Builds Function Blocks

Long-range objective is to develop molecular blocks to accomplish all basic functions of electronic systems. Blocks already developed are (1) a 5-w direct-cascaded audio amplifier, (2) a 2-stage video amplifier, (3) a frequency-selective amplifier with tunable notch-filter feedback, (4) a variety of multivibrators, (5) a variable potentiometer, (6) a variety of switching devices, (7) an analog-to-digital converter and (8) a 2-stage cooler for infrared detectors. Extension of function blocks to power sizes seems probable.

Semi-conductors differ from molecular electronic blocks in having actual electron emission from one element to another. The "electron gap" determines performance. Research in this area led Zener to predict the tunnel diode later proved by Esaki. This device is unique because of a tunable loop in its characteristic curve. The 3-terminal silicon trinistor, another semiconductor, out-does the transistor for power switching. And silicon carbide may become the emitter of a cold-cathode vacuum tube.

Crystal Study Helps Rotors, Blades

Metal physicists meanwhile study the mechanism of metal fatigue and defects in crystalline structure, seeking to devise controls to provide better materials for electrical machines. Their R&D is aimed to give engineers Martensitic structure in rotor forgings, better high-temperature properties in turbine blades. A recent breakthrough was the determination of atom distributions, permitting use of Monte Carlo techniques in computer programs to speed studies.

New developments, like Stanford Research Institute's WI-52 alloy containing 13% tungsten, permit 1,750F operation in jet-engine vanes. Allis-Chalmers has developed a machinable non-metallic sintered material which has good shock resistance and strength at 2,500F.

'Deep Freeze' Aids Material Study

Cryogenics holds peculiar fascination for science writers because about 20 metals and numerous alloys and compounds lose their electrical resistance as they approach absolute zero (–460F). Thus, they reason, continued R&D will find a way to eliminate the resistance—and most of the losses—of electrical systems. But scientists closest to this R&D seem agreed that it will find its ultimate use in small instruments, such as motor-driven gyroscopes, computer elements, and laboratory devices, which can be kept well "frozen." Any application to utility problems, they predict, will be as a research tool to eliminate unwanted phenomena, such as lattice vibration, from materials under study.

Plasma Key to Arc Control, MHD

Plasma is simply the physicist's name for ionized gas. Switchgear engineers have matched their skills against it for years in the design of circuit interruptors and have developed considerable ingenuity in quenching it by absorbing its heat, pushing it into instability, or confusing it with magnetic fields.

But plasma has a new appeal today as the means of extracting power by fusing deuterium in a reactor or passing incandescent gases through an MHD generator. Because this plasma retains all the destructive power of the electric arc, controlling it poses almost insurmountable problems. It is too hot to be confined by conventional solids. Accordingly, physicists seek to contain it with magnetic fields while they measure its internal reactions and pressures, its scattering and loss rates, and methods for regulating its ionization.

Insulation Problems Varied

Insulation for such future applications as EHV cable may be radically different from the types which have brought the industry to its present status. For the dielectric losses and charging currents of EHV cable may exceed the capability of impregnated paper. Future advances seem to hang upon these two prospects: (1) That paper can somehow be modified to lower its specific inductive capacity and losses without impairing its insulating qualities; and, (2) that a synthetic insulation, like polyethylene, can be developed to withstand EHV stresses.

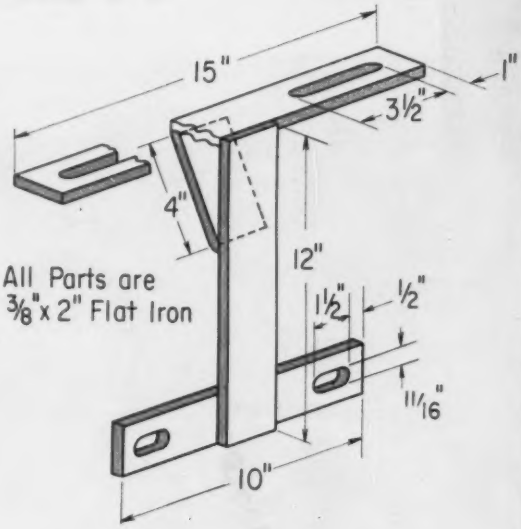
Transformer insulation will benefit from Edison Laboratories' analyses of heat transfer in gases, liquids, and solids, and from Westinghouse study of corona damage and incipent breakdown of insulation at gradients below the corona point. Allis-Chalmers looks to analysis of dielectric fields and shifting the stress to solid insulation for further improvement.

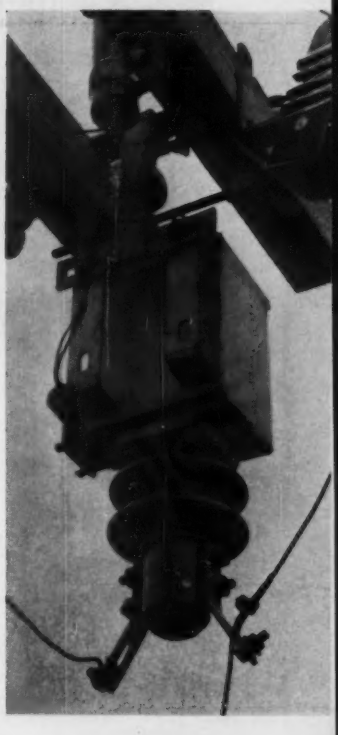
Simple Hanger Mounts Older CT's

G. A. BERO, Meter Supervisor, J. E. LeCOMTE, Foreman, Ohio Power Co, Tiffin, Ohio

A simple hanger provides an excellent means for pole-top installation of older CT's that cannot be base-mounted according to present meter and distribution standards of Ohio Power Co. The hanger saves at least 15 man-hr plus from $25 to $100 for materials per installation. The final installation is much safer, offers less wind resistance, and requires less covering up for maintenance.

The former method for old-style CT's on metering jobs required a complicated multiple-crossarm construction. Use of the simple hanger requires only one set of double arms when oil-filled pole-mounted CT's are used. There is ample room on the single set of arms for cutouts if they are not mounted elsewhere.



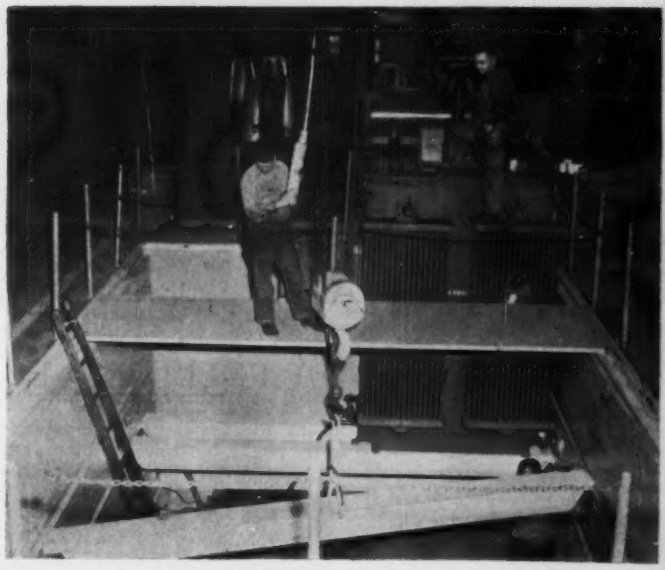


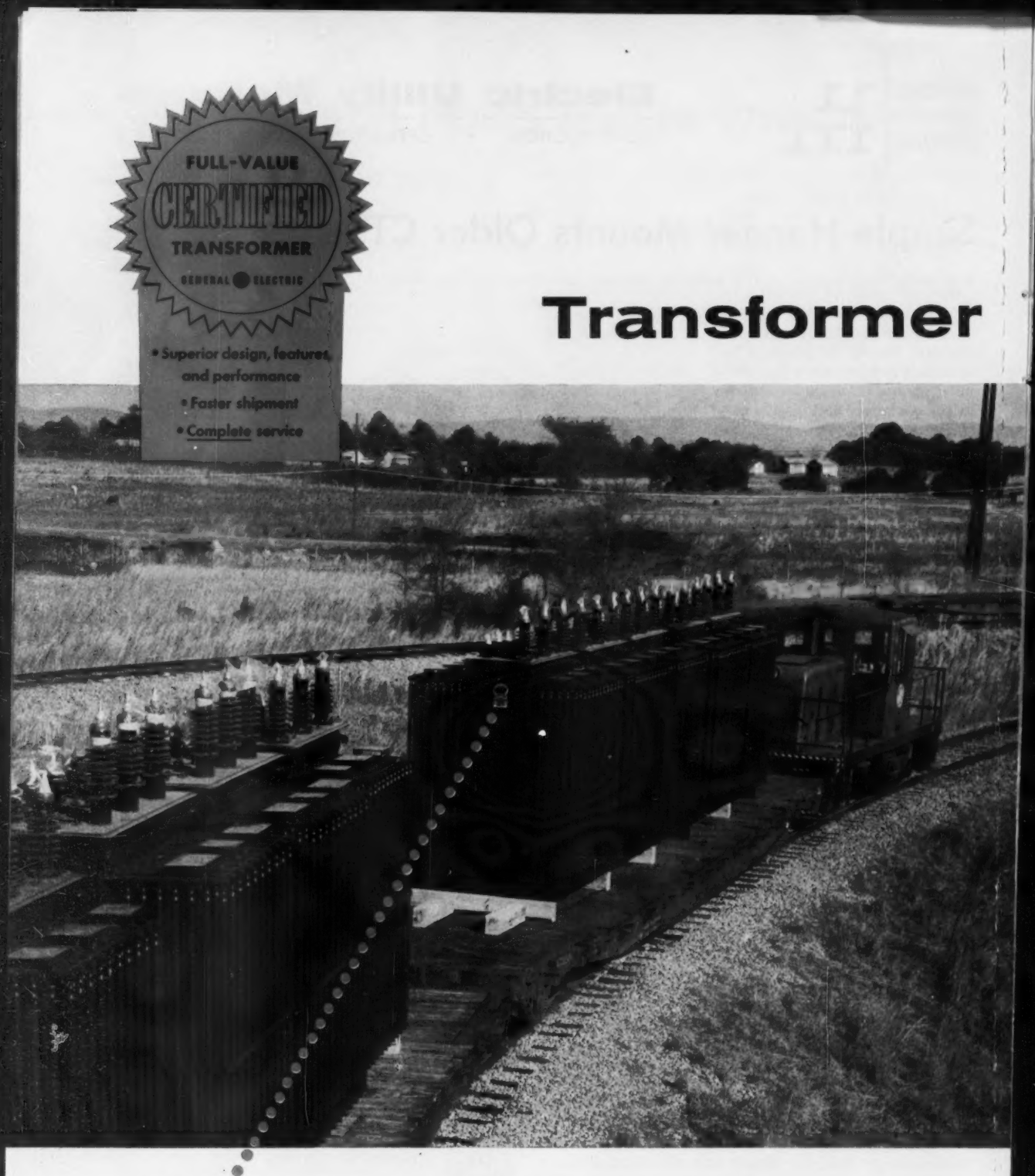
Tank Pit Eases Transformer Maintenance

Transformer maintenance was given special attention when Oklahoma Gas & Electric Co built shop facilities at its new service center. The transformer de-tanking pit provides the necessary head room to permit the crane to lift the core out of the largest transformers to be maintained at this location.

Special features of the OG&E set-up contribute much to the ease with which maintenance work can be done and therefore result in saving time as well as energy. Movable beams provide support for transformers in the pit. Ends of the beams fit into slots in the sides of the pit. Sets of slots are at different elevations so that the beams can be adjusted to place the transformer in the most convenient position for maintenance. Beams are handled by the crane.

For added convenience, cover plates that fit across the top of the pit provide a convenient work platform for maintenance men. A transformer can be enclosed with these cross plates so that men can work easily, with their work in the most convenient position. By standing in the pit or on the cross plates, men can easily reach any part of the transformer.





SYMBOL OF FULL VALUE

With this seal, General Electric certifies full value for your transformer dollar; full value in terms of superior basic design, features, and performance . . . plus faster order handling and shipment . . plus complete service before, during, and after installation. No other transformer manufacturer can match this complete General Electric package.

shipment now 20% faster

Use of digital computer reduces design time; permits faster production, delivery of General Electric medium transformers

Faster product designing—through the use of a digital computer—now makes it possible for General Electric to reduce medium transformer* shipment schedules by as much as 20 percent.

Single-phase and many smaller three-phase units in the 501- to 7500-kva ratings are now shipped in five weeks! No more than six weeks are required for shipment of the largest standard-design three-phase units.

This faster shipment is the result of General Electric's efforts to reduce time spent in transformer design engineering. Normally, 40 hours of engineering are required for preliminary design —*now, with the computer, it takes just 20 minutes!* On final designs, the computer quickly selects proper sizes for all transformer parts—core, winding and tank. Sizes and weights to best meet specifications for a complete transformer and individual parts are computed in minutes. *This reduction in design time and expense is passed on as a direct shipment and product quality benefit to you.*

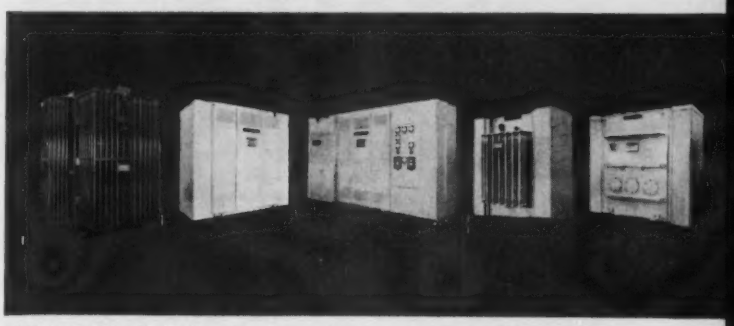
Computer-designed General Electric transformers also feature many basic improvements, including up to 20 percent reduction in height with negligible increase in floor space, and weight reductions up to 8000 pounds.

Ask your G-E Apparatus Sales Engineer to point out the many ways you save time and money with computer-designed transformers—another result of General Electric's *continuing* Certified Full-value Transformer Program. General Electric Company, Schenectady 5, N. Y.

416-30

*501 to 7500 kva, 69 kv and below.

DIGITAL COMPUTER cuts engineering and shipping schedules on G.E. medium transformers, saves customer time and money.



FULL LINE of Full-value Transformers by General Electric—left to right—Medium, Open Dry-type, Integral Distribution Centers, Distribution Equipment and Sealed Dry-type.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Procurement & Products

SPEECH ▶ **Businessmen must awaken to the basic morality in profit,** or totally succumb to the immorality which is engulfing the country as a by-product of the attacks on profit, John R. Conrad, president, S&C Electric Co, told the American Power Conference in Chicago recently. The degree of morality attached to the concept of profit in the '60's will determine the degree of prosperity that will be achieved, he said.

Referring to indictment of electrical manufacturers for alleged anti-trust violations, Conrad said, "The irony is that the profits of these defendants have not been inflated by these actions. They (the profits) were and are substandard for most of the products within the scope of the alleged conspiracy. We would conclude that survival was the motivating force behind the alleged conspiracy. Product profit and survival was the stake, rather than corporate profit and survival."

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Streamline purchasing procedures. Use of electronic data processing, for example, can eliminate much time-consuming checking, writing, comparing, and counting—leaving more time for evaluation and decision making.

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New Equipment . . . . . page 86
Readers Service . . . . . page 99

ARE YOU TAKING ADVANTAGE OF THE BONUS FEATURES ON GENERAL ELECTRIC DISTRIBUTION TRANSFORMERS?

GENERAL ELECTRIC

FULL-VALUE
CERTIFIED
TRANSFORMER
GENERAL ELECTRIC

• Superior design, features, and performance
• Faster shipment
• Complete service

Transformer s

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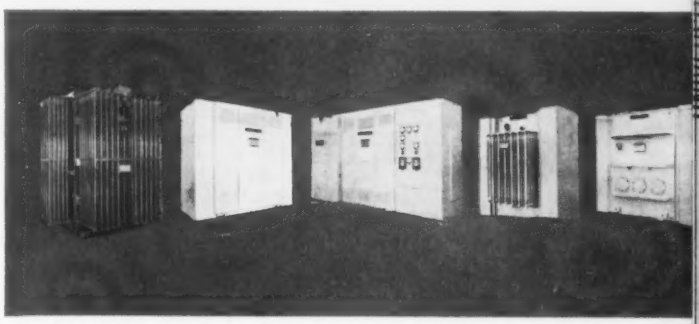

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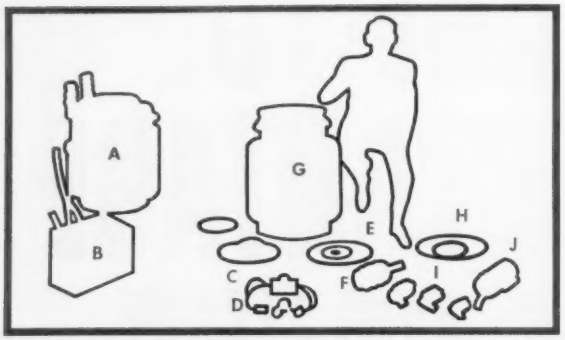
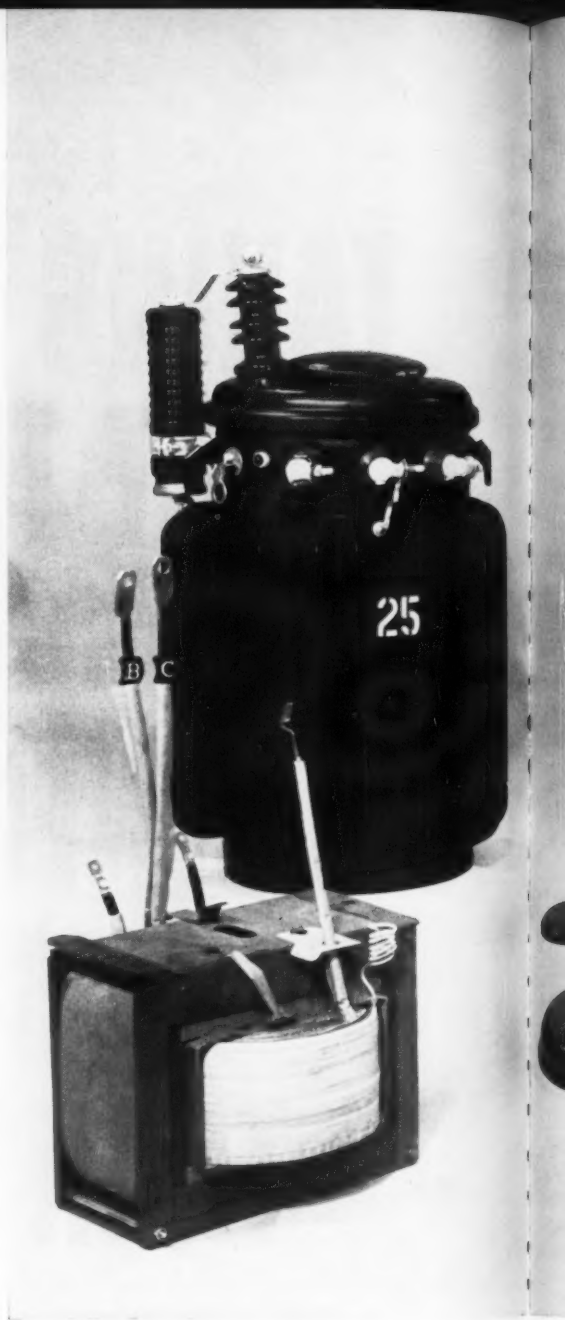


(A) NEW G-E DISTRIBUTION TRANSFORMER; (B) Permalex* insulated coils; (C) Melalast* finish cover; (D) breaker with new settings; (E) Nitrile rubber gaskets and overload light; (F) new high-voltage bushing; (G) steel tank; (H) stainless steel clamps; (I) Strenicor terminal clamps; (J) Thyrite* Magne-valve arrester.

On General Electric Distribution Transformers, in Addition to 20% Extra Loadability . . .

Bonus Features Reduce Operation and Maintenance Costs



Get higher loadability with new Permalex insulation-plus outstanding bonus features

* Trademark of General Electric Co.

J. O. SWEENY, Manager—Product Planning, Distribution Transformer Department, and the components of a General Electric 25-kva distribution transformer.

General Electric distribution transformers feature Permalex insulation for 20% added loadability—*plus* important bonus features that can mean day-to-day savings in operation and maintenance. For example:

New Melalast finish on cover prevents costly animal-caused outages, eliminates need for guards or taping.

New breaker settings make extra loadability usable.

Stainless-steel clamps, and Nitrile rubber gaskets simplify maintenance, resist corrosion.

Strenicor terminal clamps virtually eliminate secondary failures.

Thyrite Magne-valve lightning arrester provides optimum protection against lightning surges.

Feature by feature, G-E distribution transformers offer you greater value for your dollar. Ask your G-E Sales Engineer for more details—and the 10 reasons why General Electric is your best transformer buy. Or write for bulletin GEA-6070, to Sect. 431-90, General Electric Co., Schenectady, N. Y.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Manufacturers Boost Transformer Ratings

Westinghouse introduces 12% higher ratings for all self-cooled, oil-immersed transformers . . . General Electric announces 12% rating hike for self-cooled distribution and medium power transformers . . .

New distribution and power transformer ratings which will reduce utilities' transformer investment costs have been announced by two manufacturers. The ratings are attributed to improved insulation systems which were recently applied to their oil-immersed distribution transformers, network transformers and certain power transformers.

There is no additional charge for the new transformers and they have the same life expectancy as older units. Savings may be achieved either through increased loadability for the same life expectancy or a longer transformer life for the same load, or both.

Distribution Transformers

Westinghouse Electric, first to release the announcement, said its new 2,400 and 7,200-v distribution transformers, rated 25 kva, will operate at 65C.

Called "Hi-Load-65" transformers, these units offer reduced operating cost brought about by the reduction of copper-to-iron loss ratio from 3:1 to 2:1. Also, the change in copper loss results in a 14 to 20% lower impedance which, in turn, decreases the voltage drop in the transformer. This relieves the voltage limitations on loadings and provides increased revenue due to high service entrance voltage, estimated at $3 to $12 annually per transformer.

Despite the higher operating temperature of the Hi-Load 65 units, the same thermal overload capacity (180% of name plate) on the CSP units is offered. This is possible because of the combination of (1) reduced loss ratio; (2) new high-temperature insulating oil which is completely compatible with existing transformer oil; and (3) the development of an improved Insuldur insulation system, which permits high operating temperatures without loss of life expectancy.

Another feature of the new Insuldur insulation system is the reduced shrinkage in insulation during the operation of a transformer.

In addition to improved insulation and lower operating cost at high temperature, the new Hi-Load 65 distribution transformer features reduced weight and space at the pole top and reduction of cooling fins.

General Electric offers Permalex insulated transformers, identified as 55C/65C, with new ratings giving a 12% bonus to ASA distribution transformers through 500 kva and to network transformers with ratings through 2,500 kva. The basic rating is the ASA kva based on an average winding temperature rise not to exceed 55C above standard ambient.

GE'S PERMALEX-INSULATED transformers (55C/65C) hike ratings of old units 12%, offer same life expectancy

Medium Transformers

Use of Permalex also permits continuous operation of medium power transformers at 65C average temperature rise, with a 12% higher kva capacity and no loss in transformer life, says General Electric's D. B. Lawton, general manager of the medium transformer department, Rome, Ga.

New ratings apply to self-cooled, 501 through 7,500 kva transformers with primary application in utility substations or on utility distribution systems. Adding the fan-cooling gives medium transformers capability over and above the 65C Permalex rating. Transformers rated 501 through 2,499 kva gain 15%; transformers 2,500 kva and above, 25%.

Westinghouse's new insulation structure permits operation of power transformers at 65C with normal life exceptancy. Name plates of all self-cooled, oil-immersed power transformers will include a supplemental rating 12% higher than the 55C rating. Triple-rated and forced-oil-cooled transformers will have a rating 10% above the 55C rating.

The new Insuldur insulation system is also being incorporated in all oil-immersed power transformers.

(More News of Manufacturers, page 80)

Spray or spread—

either way there is a Du Pont brush killer for economical, long-term brush control

Spray . . .

To control more kinds of brush effectively in your rights-of-way, use Du Pont "Ammate" X weed and brush killer. "Ammate" X kills brush roots as well as tops, reduces resprouting later on. Because "Ammate" X is non-volatile, too, it can be used safely adjacent to nearby crops sensitive to vapor damage.

• Brush was sprayed on this right-of-way with "Ammate" X in an emulsion of oil and water. L. A. Killough, manager of the Pioneer Electric Cooperative, Greenville, Alabama, shows the brush control that existed three months later.

Spread pellets . . .

Wherever a man can walk or an aircraft can fly, brush can be controlled by simply spreading dry pellets of Du Pont "Dybar" fenuron weed and brush killer. With "Dybar" there's no mixing; it's applied just as it comes from the bag. A little "Dybar" goes a long way; for basal treatment, one tablespoonful is all that's required to kill an average brush cluster. Once on the ground, "Dybar" is carried by moisture into the soil, where it is taken up by the roots to kill the brush.

• An application of "Dybar" to the right side of Georgia Power Company's Waynesboro 110 KV line right-of-way produced the excellent brush control shown here.

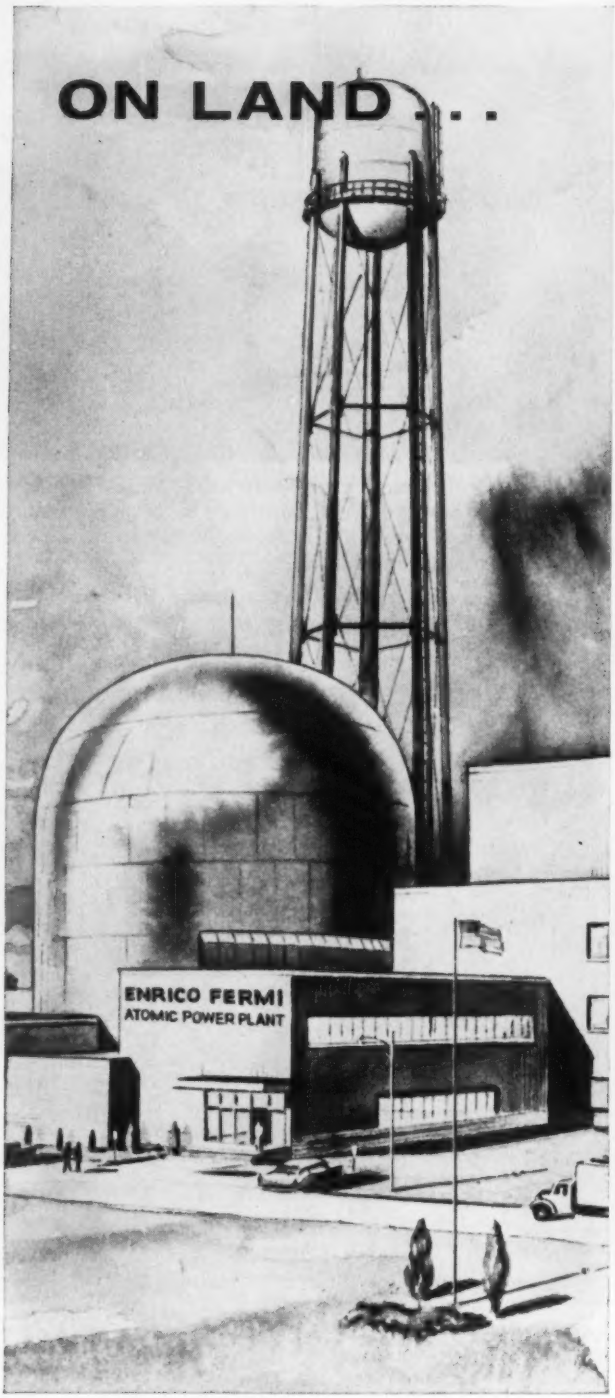
For low-cost maintenance around substations, pole yards or other areas where weeds and grass are a problem, use Du Pont "Telvar" monuron or "Karmex" diuron weed killers.

On all chemicals, follow label instructions and warnings carefully.

DU PONT
REG. U.S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING
. . . THROUGH CHEMISTRY

Weed and Brush Killers

AMMATE® weed and brush killer · **DYBAR**® fenuron weed and brush killer · **TELVAR**® monuron weed killer · **KARMEX**® diuron weed killer · **TRYSBEN**® **200** weed killer

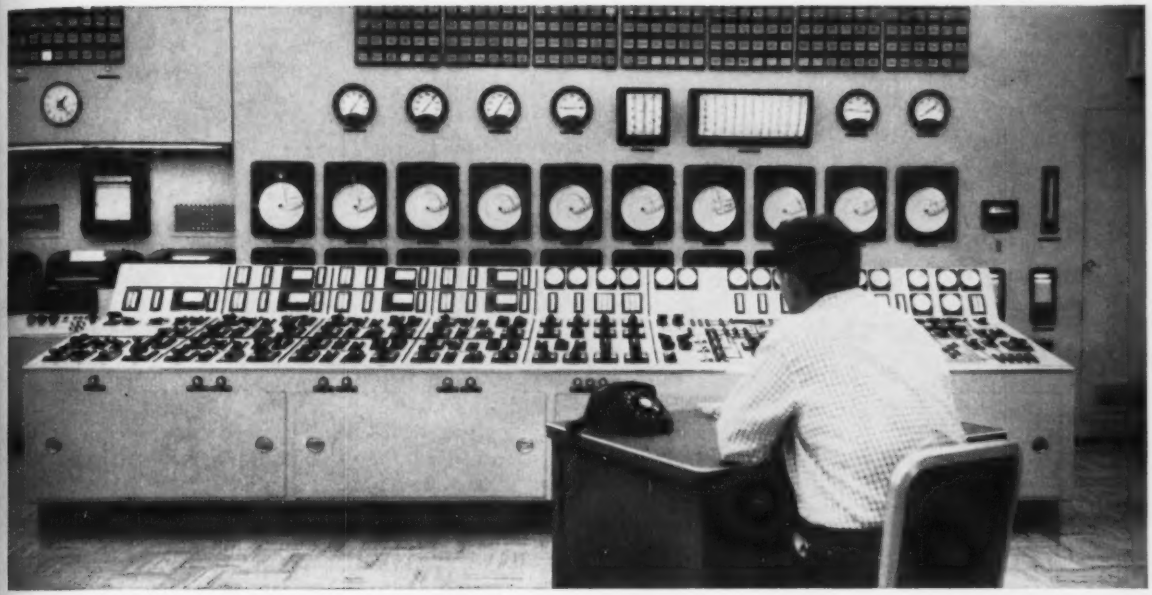


At the Enrico Fermi Atomic Power Plant, instruments and controls for both the "fast neutron breeder" reactor and the steam plant which it will "fire" are being furnished by Bailey.

Many of the new ships such as this super-carrier, USS Ranger, operate their boilers by Bailey Meter Control. Cargo ships, tankers, and passenger liners as well as Naval ships improve the economy and safety of their steam plants thru use of Bailey controls.

At the Thomas H. Allen Electric Generating Station of the City of Memphis, Tenn., Bailey operating indicators and controls for combustion, feed water, and steam temperature are centralized on the mechanical bench-board directly ahead, while the operating records which reflect trends are mounted on the vertical boards. A Bailey METROTYPE Information System, center left in the photo, scans, monitors, and logs functions usually assigned to strip-chart recorders.

IT'S BAILEY. . .



for the latest and safest instruments and controls for nuclear and conventional power plants!

Many of the power plants of the future will have controls and instruments designed and built by Bailey. There are two reasons: Bailey's continuing research and development toward the latest equipment for industry's needs; Bailey's 40-year association with the hardware and economic requirements of the industry.

If you are planning new or improved power plant facilities, call on Bailey engineers to assure that your system will have the *proper balance both as to economics and needs . . . that there will not be the unnecessary expense of over-instrumentation or control . . . nor the duplication of equipment functions.*

Call on Bailey for primary sensing devices, indicators, loggers, control units, panels, data handling equipment, computers for performance analysis, and supervisory controls. You'll find designs ranging from conventional to the most sophisticated . . . mechanical, pneumatic, electric and electronic, including solid state.

There's a Bailey District Office or Resident Engineer close to you. Check your phone book, or write direct.

A144-2

BAILEY METERS

Instruments and controls for power and process

BAILEY METER COMPANY

1060 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

*Trademark

"Superforms* handle well" ... say CONSTRUCTION and MAINTENANCE ENGINEERS

"Superforms require no tools for regular use . . . they are readily adaptable for hot-line tools . . . they give us uniformity of application and result . . . they *handle well!*"

Construction and Maintenance Engineers . . . the men responsible for *getting things done Fast, Right and at Low Cost* . . . are making more and more use of Fanner Superforms, everywhere!

A-1589A

FANNER Superformed* with a "PROTECTIVE TWIST"

ARMOR RODS . . . Protect long-span T&D lines at supports

LINEGUARDS . . . Protect short-span T&D lines at supports

PATCH RODS . . . Repair damaged conductors

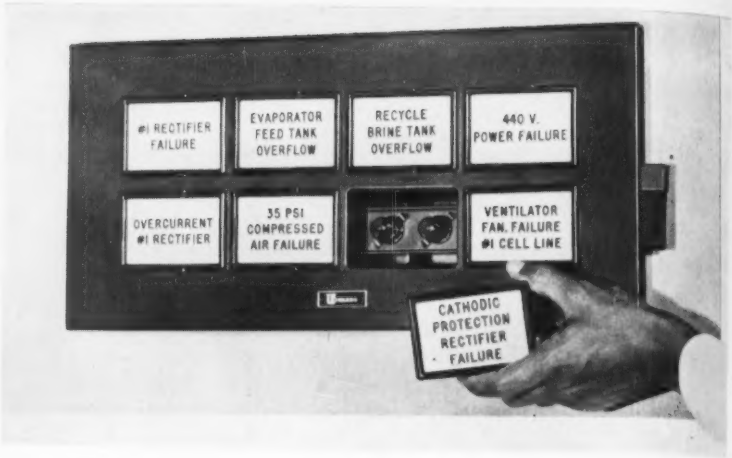
TAP ARMOR . . . Protects conductor at tapping points

FANNGRIPS . . . For dead-ending strands and conductors

FANNSPLICES . . . Join two ends of conductor wire

PLASTIC PRODUCTS . . . For conductor surface protection

FANNER
The Fanner Manufacturing Co.
Brookside Park—Cleveland 9, Ohio
Division of Textron, Inc.


#1 RECTIFIER FAILURE
EVAPORATOR FEED TANK OVERFLOW
RECYCLE BRINE TANK OVERFLOW
440 V. POWER FAILURE
OVERCURRENT #1 RECTIFIER
35 PSI COMPRESSED AIR FAILURE
VENTILATOR FAN FAILURE #1 CELL LINE
CATHODIC PROTECTION RECTIFIER FAILURE

Edwards Markets Annunciator Systems

Edwards Co, Inc, has introduced a new line of flexible, unitized industrial lamp annunciators and annunciator systems as result of a decision to expand its line and permit wider flexibility of application. Illustration of indicating panel (above) shows how plug-in plates can be removed and changed for different operational sequences. Units have a diversity of applications, including automated systems in power plants.

Up to now, the company has custom-made each installation of such annunciators and has had no standard line. When decision was made in favor of the change, Edwards sent personnel into the field to find out what was wanted in the way of lamp annunciator systems and what opinions were held on modular standard lines being marketed. The design which was established meets specified needs.

Functions of the units include monitoring of: pressure, temperature, opening of circuit breakers, high or low liquid levels, power equipment failure or any break in an electrical circuit.

Some of the system's features are: multiple lamps to insure a signal even in event of lamp burn-out; dustproof instead of hermetically-sealed units (specifically requested); sequential circuits; data-logging terminals; snap-fit, one-piece molded lamp compartments, removable without tools. There is lower power demand for operation, low power drain for each fail-safe line, which monitors its own in-operation status. Operation speed is 1½ cps.

Plug-in units can be changed without shutdown of either plant or annunciator system. No hot parts are exposed during service.

MANUFACTURERS BRIEFS

Three 180,000-hp hydraulic pump-turbines will be built by **English Electric** for two new Spanish power projects. Units are part of a $7-million order which includes three 83,333-kva airblast switchgear. The pump-turbines, which will be installed next year at Valdecanos, will be of the reversible Deriaz type, and will operate at 150 rpm with heads of 160 to 250 ft . . . **Anaconda Wire & Cable** reports 1959 sales of $141,355,814 and net profit after taxes of $3,024,553. The 1958 figures were $101,751,818 and $1,279,537, respectively . . . **Thompson-Ramo-Wooldridge Products** and **Republic Flow Meters** agree "to cooperate in designing and furnishing complete computer-operated systems for the electric power industry." . . . **Allis-Chalmers** will furnish a "power supply more potent than that of any other major atom smasher in the

(*Continued on page* 82)

THE SANGAMO P-3 GIVES ALL THE BENEFITS OF... THREE STATOR METERING

KEEP PACE ELECTRICALLY

WITH THESE PLUS FEATURES:

		P3	Other 3 stator meters Type X	Type Y	Type Z
APPLICATION	Complete Line	Yes	No	No	No
	Continuous Capacity (Amps)	200	150	175	150
	Least Switchboard Space	Yes	No	No	No
DESIGN	Number of Disks	1	2	2	3
	Smallest Size	Yes	No	No	No
	Minimum Weight	9 lbs	17 lbs	18 lbs	12 lbs
TESTING	Number of Adjustments	8	10	11	12
	All Micrometer Adjustments	Yes	No	Yes	No
	Easiest to Test	Yes	No	No	No
ACCURACY	Disk Speed (Rpm)	8⅓	30	16⅔	30
	Lowest Starting Watts	Yes	No	No	No
MAINTENANCE	Sectionalized Construction	Yes	No	No	No
	Cover Replacement Cost	$2.56	$3.71	$10.25	$7.05

Sangamo has developed this three-stator polyphase meter to meet the measurement problems created by today's large loads. The P3 is the smallest, lightest three-stator meter made . . . the only one with single disk, round cover, modern design. It is a slow speed meter. And, it is the only three-stator meter with full 200 ampere capacity. Fill your three-stator metering requirements with Sangamo's complete line of P3 Meters (Class 10, 100, and 200 in socket and bottom-connected construction).

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

SANGAMO

JH60-2

MARCUS TRANSFORMERS SCORE

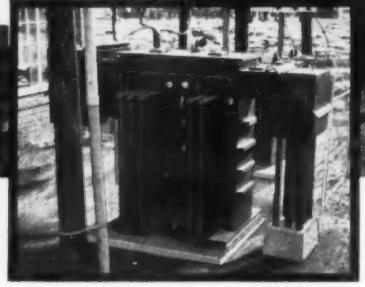
Excellent

IN ALL TESTS . . .

From brawny, liquid-filled transformers outside of the Math and Physics Building, Field House, and Fine Arts Building, to whisper-quiet dry type units in the classrooms, laboratories, and dramatics hall, the University of Wichita uses Marcus transformers for dependable, trouble-free performance.

All Marcus transformers, both dry and liquid-filled score "excellent" in factory tests. Loss tests, hi-pot tests, impulse tests, and sound-level tests are passed with flying colors. For full power and guaranteed satisfaction, specify Marcus for *your* next transformer installation.

UNIVERSITY OF WICHITA



1500 KVA OIL FILLED TRANSFORMER

MARCUS MTC "Mark of Quality"

Representatives in Principal Cities

MARCUS TRANSFORMER CO., Inc.

RAHWAY, NEW JERSEY

A COMPLETE LINE OF DRY TYPE AND LIQUID-FILLED TRANSFORMERS THRU 5000 KVA

Manufacturers Briefs

(*Continued from page* 80)

U.S." to the Argonne National Laboratory. Power is for the 12-billion electron volt-zero gradient synchroton being constructed at Lemont, Ill . . . **Service Products, Inc,** has been awarded two contracts to furnish and apply insulation for Enrico Fermi atomic power plant. About 20 railway carloads of Kaylo high temperature pipe and block insulations made by Owens-Corning Fiberglas will be applied to steam lines, turbine generator and auxiliary lines carrying high-pressure steam and heat. Work is scheduled for October first completion.

Expansion

Robertshaw-Fulton Controls will complete a $4-million plant at New Stanton, Pa, in mid-1960, bringing manufacturing facilities up to $110-million value. When the new plant swings into operation, plants at Youngwood and Scottdale, Pa, will be sold. Robertshaw reported 16% increase in 1959 sales over previous annual figure, or $79,494,-038. Net earnings rose 44% . . . **Thermoid Div, H. K. Porter, Inc,** will spend about $225,000 on new manufacturing equipment used to further control and improve electrical characteristics of its pressure-sensitive tapes. Greatest single improvement in tapes will be a new coating machine which is syncronized to perform a variety of operations. The machine applies pressure-sensitive adhesives to backing material, dries the coated material in oven-temperature zones and cools and stabilizes the final adhesive coating in a refrigeration zone.

New Methods

Modern, continuous push-button controlled lines for surface treating and painting of pole-type distribution transformers is in operation at **Allis-Chalmers'** Pittsburgh works. Transformer tanks, attached to an overhead conveyor system, are first cleaned, given all-over phosphate coating, then flow coated and moved through a baking tunnel after each applied coat.

(*More Procurement & Products, p* 86)

Two steel spirals conduct inert gas to all parts of cable to prevent ionization and provide self-supervisory properties.
Impregnated paper insulation, with shielding.
Solid copper tubing is open at splices, assuring constant gas pressure in spiral tubes.
Non-magnetic shielding tape over cable core.
Tellurium-Lead Alloy Sheath resists bending fatigue, creep, age-hardening, abrasion; has outstanding heat stability.
DRUG
Bar and Grill

KEEPS UPHILL POWER "ON THE LEVEL"!

ROEBLING GAS-FILLED CABLE

What happens when solid-type cable is used on steep grades? if you've used it, you know! The oil impregnant simply obeys the law of gravity and drains to the bottom of the grade. At the low point, hoop stress (caused by oil pressure build-up) makes the lead sheath stretch. Eventually a rupture occurs. And in the areas drained of oil, ionization takes place.

What's the answer to this constant (and inevitable) problem? *Roebling Low-Pressure Gas-Filled Cable*—for voltages up to 46 kv! Dry nitrogen gas, inside this cable at approximately 12 psi pressure, provides consistent dielectric properties throughout the length of the cable. No matter how steep the grade, internal pressure is uniform everywhere.

Another feature of this cable is that it is self-supervisory—an alarm system lets you know if there's trouble along the line.

Roebling Low-Pressure Gas-Filled Cable is as easy to splice as solid-type paper power cable. It offers the least expensive long-term answer to the problem of transmitting power uphill! Get the whole story from your Roebling Field Representative soon. Electrical Wire, John A. Roebling's Sons Division, Trenton 2, New Jersey.

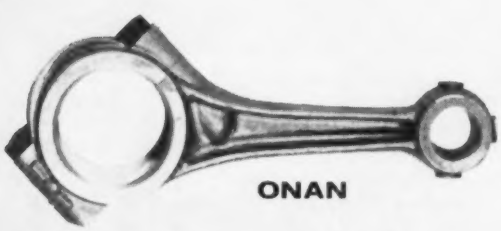
ROEBLING

Branch Offices in Principal Cities
John A. Roebling's Sons Division, The Colorado Fuel and Iron Corporation

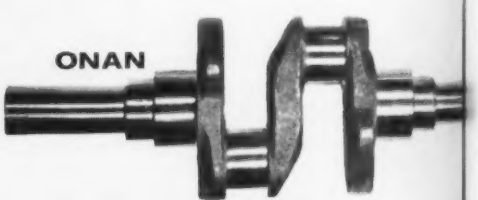
Big, beefy bearings make than ordinary

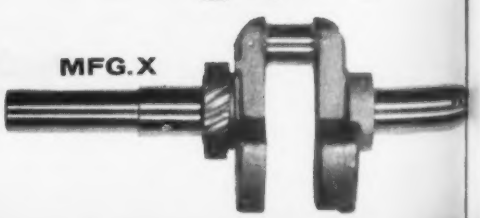
Look at the brawn in this Onan bearing from a 20 HP engine—more than twice the bearing area of most competitive bearings. Look at the built-down-to-a-price bearing from a 20 HP competitive engine. It's about half the size. Which bearing do you think would last longer?

Connecting rods—The shorter stroke of the Onan engine permits the use of a shorter rod, a more rugged design that stands up longer under heavy duty service—another example how Onan builds *up* to performance, not down to a price.



Crankshafts—Larger diameters of main and rod journals make Onan crankshafts stiffer and stronger, minimizing the possibility of breakage or bending. More "muscle" throughout Onan engines means longer life, extra years of full-rated performance.





Onan last years longer electric plants

Onan bearings are about twice the size of most competitive bearings

Bearings take a beating in any engine. But, with Onan's bigger bearings the strain is spread over a wider area, giving you longer, more economical engine life.

This is just one example of the extra quality you find in Onan Electric Plants. Each one is checked out at full load for hours before it goes to the shipping dock. Engineers have designed 134 separate tests to make sure it operates the way it is supposed to. Not only that, inspectors from independent laboratories pay surprise visits to the Onan factory, pull units off the line and put them through their paces. It's a double check—on Onan tests and testing methods.

There's an Onan representative near you, ready to tell you about the complete line of Onan Plants, from 500 watts to 230,000 watts. Look for his name in the telephone classified section in all major cities, or write direct.

ONLY ONAN GIVES YOU THIS GUARANTEE

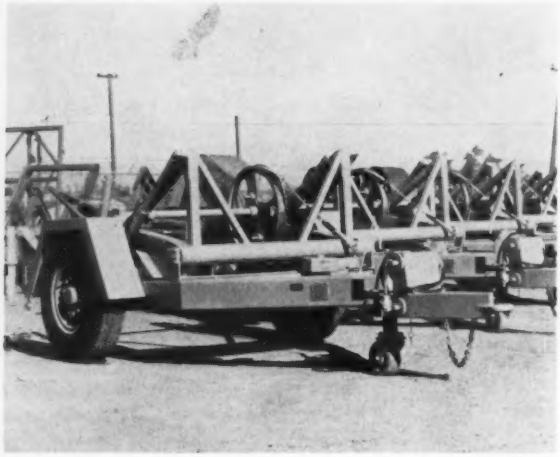
PERFORMANCE CERTIFIED
We guarantee that when properly installed and operated this Onan electric plant will deliver the full power and the voltage and frequency regulation promised by its nameplate and published specifications. This plant has undergone several hours of running-in and testing under realistic load conditions, in accordance with procedures certified by an independent testing laboratory.
D. W. ONAN & SONS INC.
Minneapolis 14, Minnesota
Onan

Onan®

World's Leading Builder of Electric Power Plants

D. W. ONAN & SONS INC., 2540 UNIVERSITY AVE. S.E., MINNEAPOLIS 14, MINN.

(For further information refer to Readers Service on page 94)

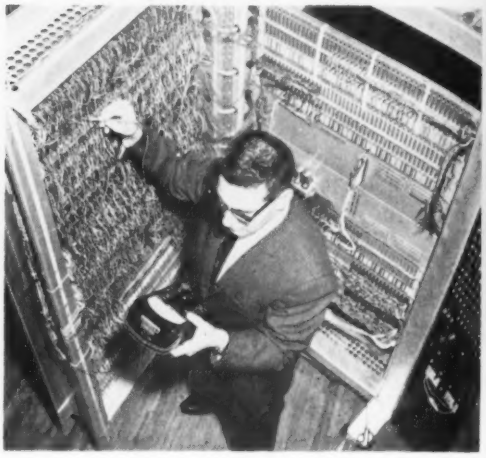


Reel-Carrying Dolly . . .

. . . for any line stringing operation takes reels up to 46 in. wide and 84 in. dia in weights to five tons. A manually operated hydraulic device loads reels onto the straddle-type dolly. A front tow hitch permits towing behind truck or tractor, with or without a winch. A smaller and a larger model than this 6100 HLRC PENGO reel carrier are also available.
Petersen Engineering Co, Inc, Santa Clara, Calif.

Digital Computer . . .

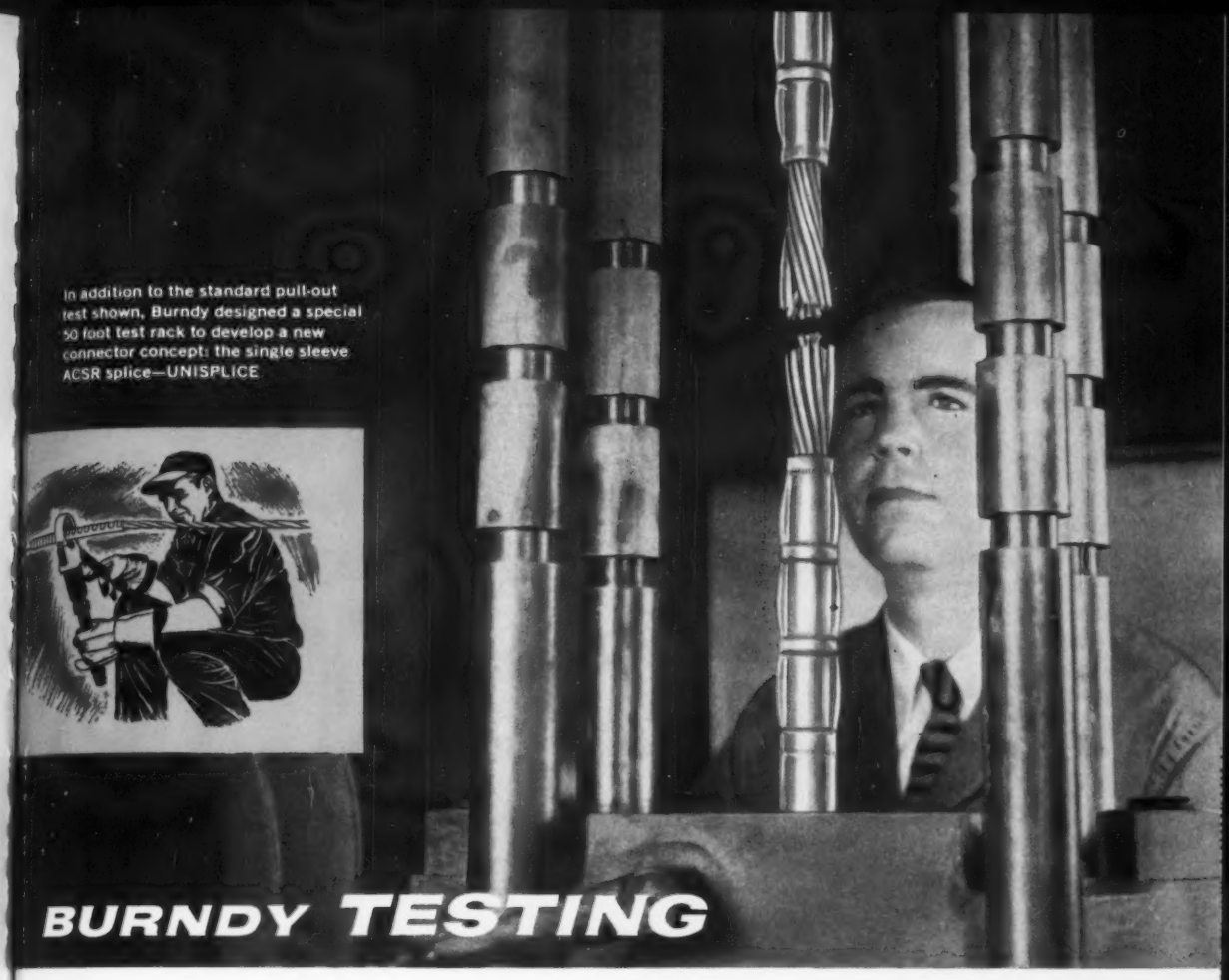
. . . handles scientific operations and complex control problems as well as conventional data. Features of the Model 2003 include 64 plug-in instruction cards, each containing a programmed order; two 64-word magnetic core buffer systems that permit the computer to accept and exchange information during uninterrupted computation; and the ability to transfer a 64-word block of input, output or internal information by a single instruction. Fast magnetic tape memory system and other peripheral equipment are also available.
Mechanical Div, General Mills, Inc, 1620 Central Ave, Minneapolis 13, Minn.



Drawout Interrupter . . .

. . . is designed for 14.4 kv service. The truck withdraws from the cubicle for fuse changing and maintenance, hence provides complete isolation from live parts. Micarta covers drop into place on withdrawal to isolate stationary contacts. The unit has a removable air switch and fuse element. Switch resists damage on fault currents to 10,000 amp and is virtually impossible to open under fault.
Continental Electric Equipment Co, 205 W Fourth St, Cincinnati 2, Ohio.

(*More New Equipment on page* 90)


In addition to the standard pull-out test shown, Burndy designed a special 50 foot test rack to develop a new connector concept: the single sleeve ACSR splice—UNISPLICE
BURNDY TESTING

concentrates

ON DEVELOPING BETTER ELECTRICAL CONNECTIONS

Developing new and better ways to make electrical connections is our total job at Burndy. Finding out exactly what happens to cable and connectors under normal and extreme operating conditions and then designing a connector that meets the conditions requires Burndy's specialized test facilities: vibration, heat cycling and heat run... conductivity... salt spray... constant tension and constant motion... pull-out... dielectric and other special tests.

Remember, Burndy is the only electrical manufacturer concentrating all its extensive facilities on the development of better electrical connections...

RESEARCH, TEST, DESIGN AND PRODUCTION LEADERSHIP

BURNDY

58-20

Norwalk, Connect. In Europe: Antwerp, Belgium Toronto, Canada

MOLONEY DISTRIBUTION TRANSFORMERS ARE DESIGNED TO MEET ALL SYSTEM REQUIREMENTS

Comparative analysis of distribution transformers invariably leads to one conclusion . . . the best distribution transformer has all characteristics of design carefully developed in respect to their contribution to system efficiency, dependability and economy.

In Moloney Distribution Transformers, no one feature, electrical or mechanical, is radically improved at the expense of another. Instead, each part of the design is carefully considered and balanced with the others, to provide a distribution transformer that will give the best all-around system performance.

Utility systems benefit from this philosophy of design because every Moloney Distribution Transformer feature is designed to perform in the best possible manner compatible with every other aspect of the design, and thus provide "More Power To You."

Desirable Features of Moloney Distribution Transformers Include . . .

High Short Circuit Strength
Mechanical Strength
Weatherproof
Corrosion Resistant
AL-CU Connectors
No Radio Interference

Here Is How They Are Achieved.

SUPERIOR PERFORMANCE BECAUSE...

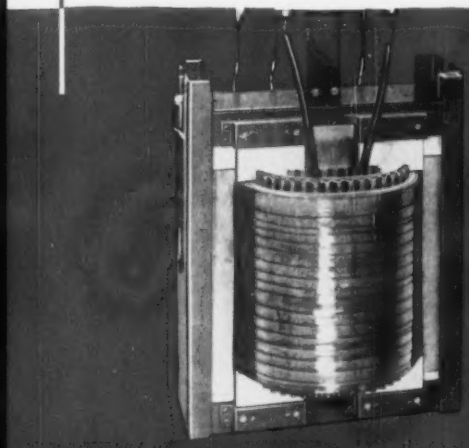
MOLONEY ELECTRIC CO.

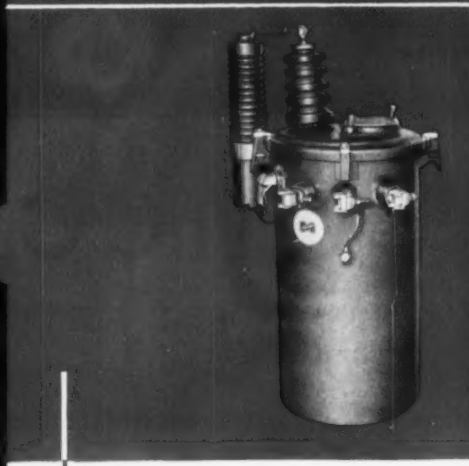
Since 1896 . . . ***MORE POWER TO YOU***

1

High Short Circuit Strength

All turns are anchored into position and resin-coated layer insulation is used throughout the coil. During the coil drying process this resin bonds the adjacent paper and wire together but does not keep the oil from penetrating all insulation. Steel frames secure wood blocks which press against the stayback on both top and bottom of the coil to hold it rigidly in position.





4

Corrosion Resistant

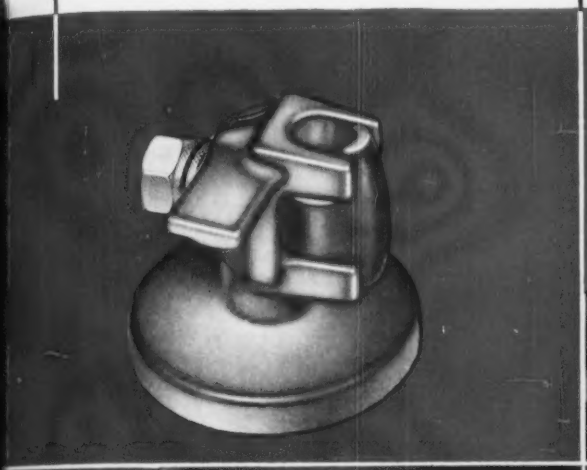
All materials used for Moloney tanks and accessories are especially selected for their resistance to corrosion and the tank, cover and base are painted with a tough, flexible weather resistant paint. The tank and cover are of heavy gauge metal and all connectors, clamps and other hardware are made of alloys which are relatively impervious to weather. All bushing mounting hardware is located internally, thus removing several possible sources of corrosion.

SALES OFFICES IN ALL

2

AL-CU Connectors

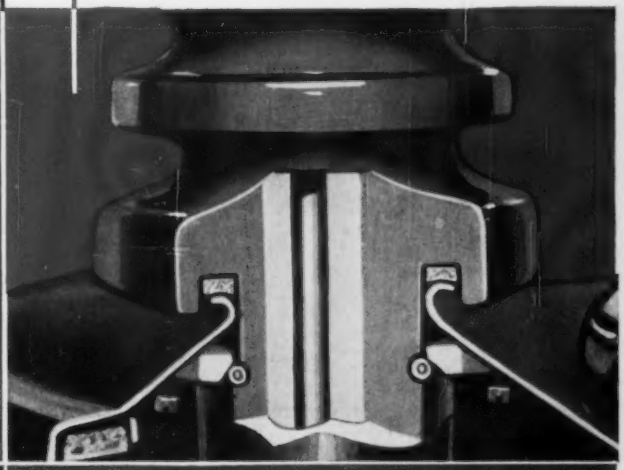
The solderless connectors are electro-tin coated and are designed to accommodate either the copper conductors specified by EEI-NEMA Standards or the ACSR equivalent. The large contact surface reduces conductor cold flow and the double-coil, spring-type washer compensates for any cold flow which may occur. Connectors are made of silicon bronze alloy to prevent twisting or breaking.

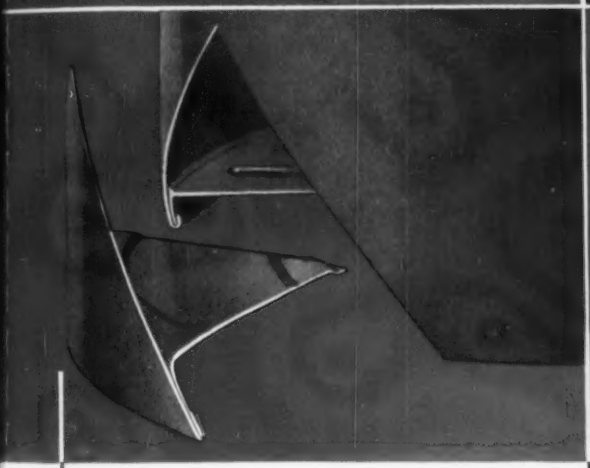


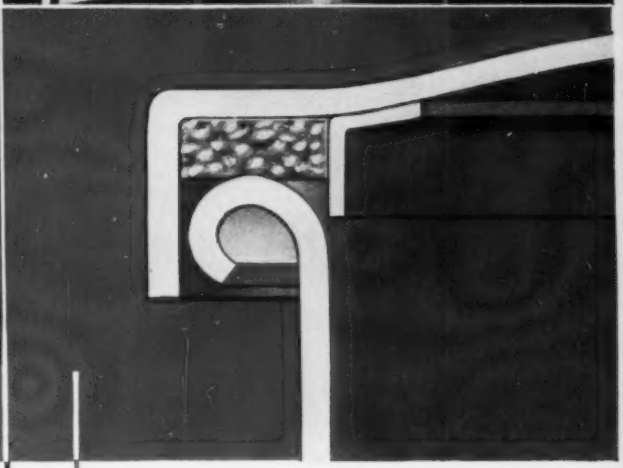
3

No Radio Interference

On voltages up to 15 KV the high voltage bushing boss is rolled to prevent the formation of corona at the point where the bushing passes through the cover. At higher voltages a conductive glaze and mounting adapter is combined with the rolled boss to prevent corona. These practices render Moloney Transformers free from potential sources of radio interference.







5

Mechanical Strength

The tank, cover, bushings and other components are designed to resist damage in shipment, handling or installation.

The metal used in the tank and cover is heavy gauge, copper bearing steel formed to give added strength at the points most susceptible to damage, especially at the tank base flange, where there is a triple thickness of metal.

All bushing corrugations have a thick vertical cross section to give the bushing high impact strength.

6

Weatherproof

To assure that the transformer is sealed from the atmosphere and the elements, bushing openings have retained corprene gaskets; cover bushings are mounted on rolled bosses whose flanges curve up and away from the opening; a corprene cover gasket seats on the rolled top rim of the tank and is retained by the rim, cover overhang, and an internal gasket retainer. The cover gasket remains in the cover when cover is removed from the tank and therefore will not stretch out of shape necessitating replacement.

ME60-5

PRINCIPAL CITIES • FACTORIES AT ST. LOUIS 20, MO., AND TORONTO, ONT., CANADA

Crapo GALVANIZED **STEEL STRAND**

WEIGHT OF COATING TEST

...added assurance of dependability

The life of galvanized steel strand depends primarily upon the weight and quality of the zinc coating. The heavier the coating the longer the strand will last.

The wire used in CRAPO Galvanized Steel Strand is regularly subjected to the hydrochloric acid antimony chloride, or weight of coating, test. By means of this test the amount of zinc on the surface of the wire can be accurately measured.

This is but one of the many laboratory tests to assure consistently high, dependable quality in the finished product.

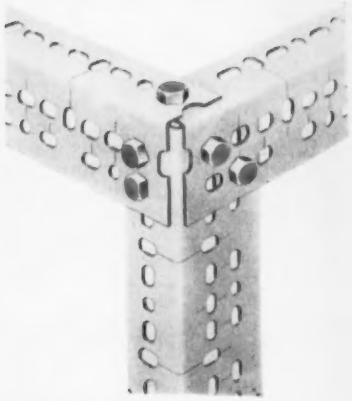
AVAILABLE IN 3 COATING WEIGHTS

CRAPO Steel Strand is regularly furnished in all standard sizes and grades and in Class A, B and C coatings. Class B coating is twice as heavy as Class A coating; Class C coating is three times as heavy.

Write for this FREE BOOKLET!

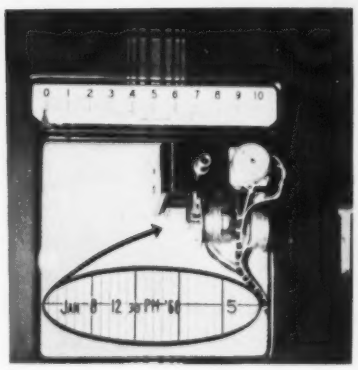
"The Story Behind CRAPO Galvanized Wire and Strand" describes and illustrates manufacturing and testing techniques. Ask for Booklet B-59!

INDIANA STEEL & WIRE CO., INC.
Muncie, Indiana



Steel Framing . . .

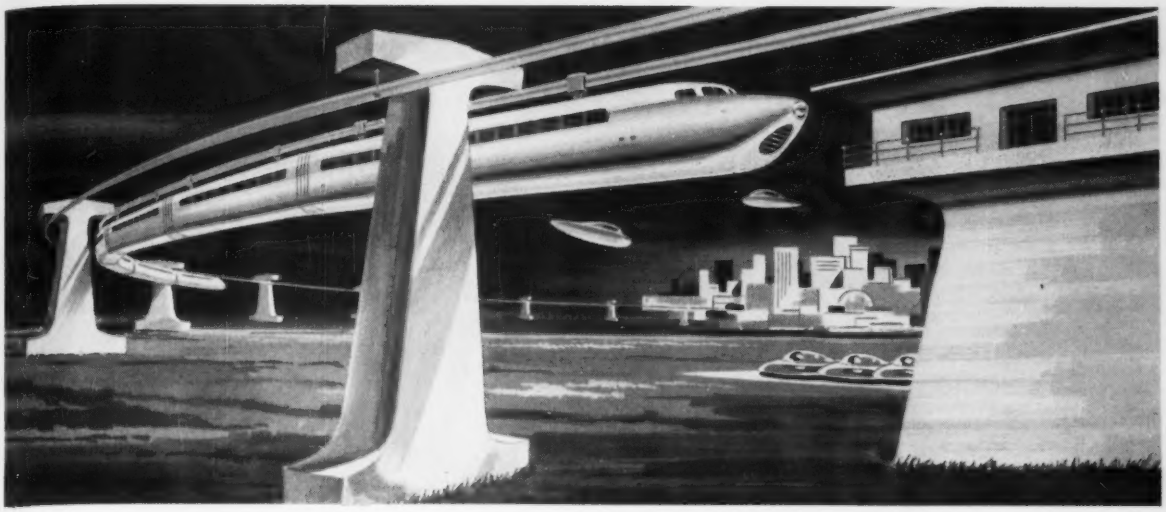
. . . has slotted angle for the suspension and structural support of electrical installations. The line, known as Right Angle framing, is made of structural quality steel. It is available in three sizes: 1⅜x1⅜ in., 0.067-in. thickness (Type RA 150); 2⅜x1⅝ in., 0.080-in. thickness (RA 225); and 3⅛x1⅝ in., 0.104-in. thickness (RA 300).
Steel City Electric Co, Pittsburgh 33, Pa.



Automatic Printer . . .

. . . notes time and code on strip chart recorders for speedy, accurate identification and interpretation of the time or sequence in which conditions occur. In an easily-installed, kit form, the device, called Identichart RI-5, provides for operation on any ac or dc voltage from 24 to 115 v. The time clock operates continuously on a 60-cps line.
Royson Engineering Co, Hatboro, Pa.

(*More New Equipment on page* 94)



NUCLEAR FUELS ARE IN YOUR FUTURE

The World's Largest Privately Owned Nuclear Fuel Producing Facility

FROM M & C NUCLEAR INC.

A subsidiary of Texas Instruments Incorporated

As soon as your reactor project starts, have your designers take advantage of our specialized experience and skills in the fabrication of fuel elements and complete core assemblies. Important economies can frequently be instituted at early stages in the planning which can contribute to lower power rates in the years of operation ahead.

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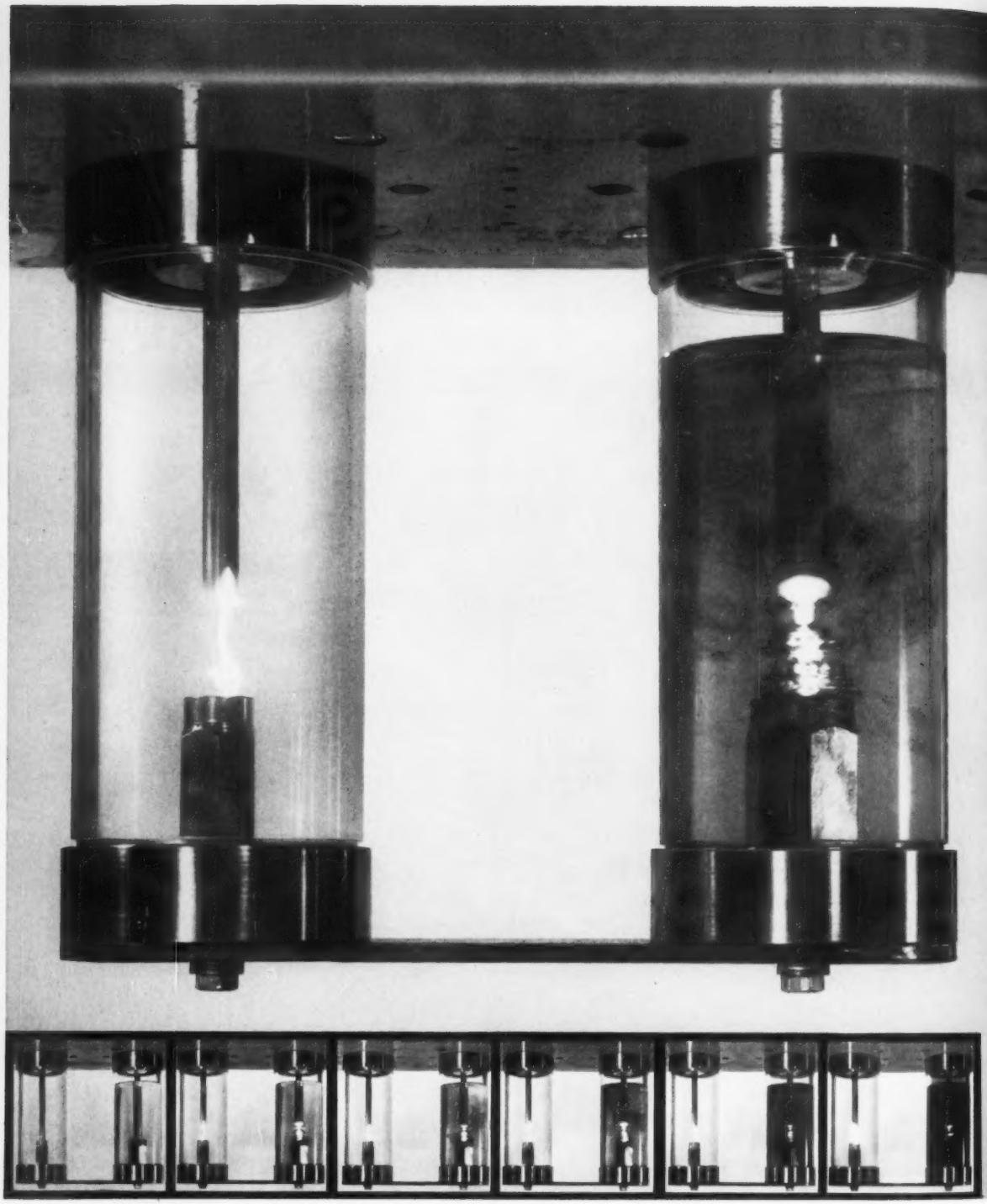
P. O. BOX 898 • ATTLEBORO, MASSACHUSETTS, U. S. A.



THIS SIMPLE TEST PROVES SF_6 (LEFT) REMAINS UNCONTAMINATED AFTER REPEATED INTERRUPTIONS...WHILE OIL (RIGHT) SHOWS EVIDENCE OF CARBONIZATION

In this demonstration, SF_6 gas has quenched a series of arcs with negligible decomposition, as proved by mass spectrographic analysis of the material before and after the test. The oil, after the same number of interruptions, has carbonized and blackened showing obvious signs of deterioration. This means that the intervals between maintenance operations on a breaker using sulfur hexafluoride gas can be greatly increased.

SF_6 gas stability cuts breaker maintenance

Makes possible greatly improved performance from 34.5 kv to 460 kv and beyond

High stability of SF_6 gas as an arc-extinguishing medium will bring you economies in the operation and maintenance of power breakers never before possible. New Westinghouse SF_6 breakers combine many of the recognized advantages of both oil and air breakers, and in some respects are superior to either.

The great stability of SF_6 (sulfur hexafluoride) assures long life of the gas as both an arc-quenching and an insulating medium, even with repeated interruptions. SF_6 has extremely high dielectric strength, recovers full dielectric properties rapidly . . . assures unexcelled arc extinction time after time. SF_6 is inert, nontoxic, nonflammable, odorless . . . entirely safe. These qualities, plus the quiet operation of the closed SF_6 gas system, make SF_6 breakers ideal for all substations . . . even in urban locations where noise may be a problem. New Westinghouse SF_6 breakers are easier and less expensive to install and to maintain than any power breaker available today.

Westinghouse power circuit breakers using SF_6 gas are basically new. But they have proved themselves at several voltages and also promise the most practical design avenue in capacities of 460 kv and beyond.

Westinghouse suggests you buy two of these new breakers in widely separated ratings and apply them in entirely different operating situations. Prove to yourself that they will give you combined performance and economy you cannot get in any other breaker.

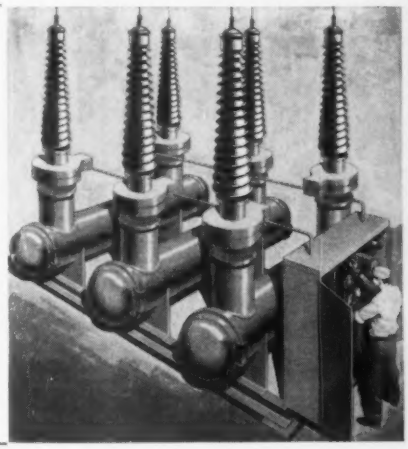
Call your Westinghouse representative today. Or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

J-60981

PROVE THE OUTSTANDING PERFORMANCE OF THIS BREAKER ON YOUR OWN SYSTEM

The principle of circuit breaker design using SF_6 gas has already been proved successful on several operating systems. Breakers from 46 kv to 115 kv have now completed over two years of service.

With SF_6 breakers you get: FAST INTERRUPTION; EASY INSTALLATION; SIMPLE, LIGHT FOUNDATIONS . . . no ground shock during interruption . . . elimination of oil and size reduction cuts weight up to 65% at 230 kv; DRASTICALLY SLASHED MAINTENANCE . . . SF_6 does not decompose . . . interrupter easily removed; COMPLETE SAFETY AT ALL TIMES . . . dead tank construction; QUIET OPERATION . . . no discharge to atmosphere . . . closed system conserves gas.



YOU CAN BE SURE...IF IT'S Westinghouse

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CONTROL

OVER 250,000 INSTALLATIONS!
A complete line of precision photoelectric controls & accessories for outdoor lighting.
PRECISION MULTIPLE CONTROLS., RIDGEWOOD, N. J.

Look to Superior for

ENCLOSURES

Superior also offers a complete line of

TEST SWITCHES
TEST BLOCKS
SOCKET EQUIPMENT

Catalog 55 offers complete information on features, services, types and sizes. Write to:

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A subsidiary of
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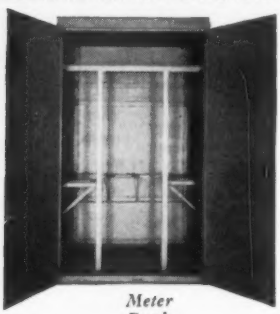
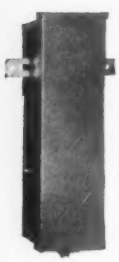
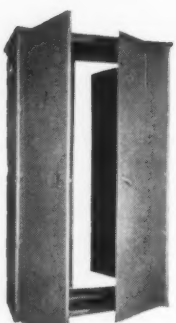


Meter Booth



Current Transformer Enclosure



Double Door Enclosure

Tractor-Shovel . . .

. . . lifts 3,000 lb and carries one-cu-yd (SAE rated) bucket. This H-30 model provides 77½ hp with four-wheel drive, four-wheel brakes and three torque-converter speed ranges in each direction. With the bucket in the dumped position, clearance under the cutting edge is 8 ft 4 in.

Frank G. Hough Co, 957 Seventh Ave, Libertyville, Ill.

Electric Vibrator . . .

. . . for moving materials through bins, chutes and hoppers is explosion-proof. Totally enclosed, the vibrator (RC-32) is approved by Underwriters' Laboratory for use in conditions which include atmospheres containing natural gas, gasoline, naphtha and similar vapors. It has a low noise level, due to the use of eccentric weights to produce vibration force, and delivers 3,600 vibrations per min.

The Wellman Co, 1405 E 6th at Rockwell, Cleveland 14, Ohio.

Product Recorder . . .

. . . houses two independent measuring systems in one case. The Model 6717 multiples and records the outputs of their electronic amplifiers.

(*Continued on page* 98)

YOU GET

LONG-LASTING PROTECTION FOR YOUR OVERHEAD SYSTEM

with

BLACKBURN *Grounding* DEVICES

Type GTC 1
One plate tower ground clamp

Type GTC 2
Two plate tower ground clamp

Copper Bonded Pigtail

Type GUV
U-bolt ground clamp parallel or 90°

Steel Driving Stud for Sectional Ground Rods

Type GG
Ground Rod Clamp
Socket set screw

Copper Alloy Coupling for Sectional Ground Rods

Copper Bonded Sectional Ground Rods

Copper Bonded Regular Ground Rods

Type GGH
Ground Rod Clamp
Square head bolt

Type B
Budget Line Ground Rod Clamp
Square head bolt

Type GP 100
Electrolytic Copper Pole Bottom Plates
7½", 10", 14" dia.

Blackburn grounding devices will save you thousands of dollars annually in preventing burnouts of expensive overhead equipment. This complete line simplifies your stocking problem—one source for all your needs. Like all BLACKBURN products they are constructed of high-strength corrosion resistant materials—designed for easy installation and engineered for long-lasting, trouble-free grounding. Always specify BLACKBURN.

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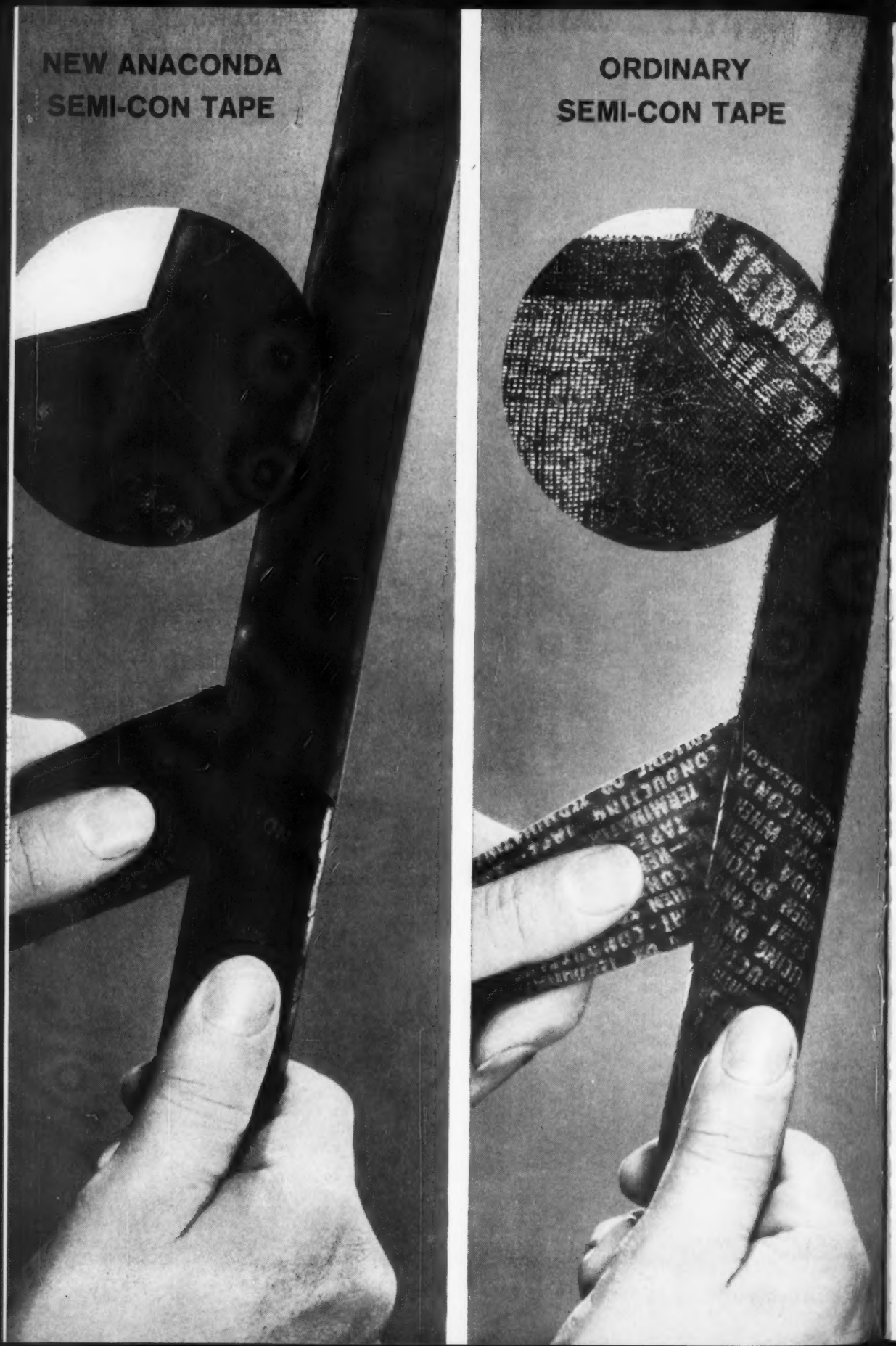

NEW ANACONDA
SEMI-CON TAPE
ORDINARY
SEMI-CON TAPE

NOW YOU CAN GET SAFER, FASTER, MORE RELIABLE JOINTS AND TERMINATIONS ON HIGH-VOLTAGE CABLE

Anaconda Durasheath has a new clean-stripping, semi-conducting tape

PROBLEM: To make a sound, safe, high-voltage splice, every last speck of semi-conducting tape material must be removed from the insulation . . . if traces remain, chances are the joint will eventually fail. But—this important step requires tedious scraping and buffing.

SOLUTION: The new Anaconda-developed *clean*-stripping, semi-con tape, which is an exclusive feature of Durasheath Cable. The photos (left) were taken immediately after semi-con tapes were stripped off the insulation. It takes much longer to get other cable insulation surfaces as clean. That's why this exclusive feature makes splicing a great deal easier.

The planned research and production program which brings you this outstanding cable development is also responsible for the equally important developments in Butyl rubber insulation compounding and extruding—which have produced the best possible balanced design and construction in high-voltage rubber insulated cable obtainable today – Anaconda Durasheath.

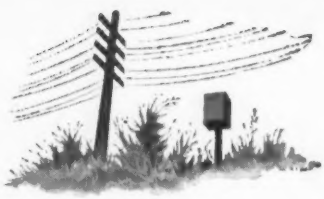
For additional, more technical information abou Anaconda Durasheath, write for Anaconda Bulletins DM-5903, covering Durasheath High-Voltage Cable and DM's-5566, -5720 and -5735, dealing with th splicing and terminating of Durasheath Cable. Contac your nearest Anaconda Wire & Cable Company dis trict office, or write to 25 Broadway, New York 4, N. Y

ASK THE MAN FROM

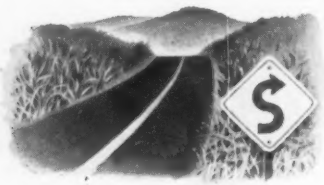
ANACONDA®

FOR DURASHEATH® CABLE

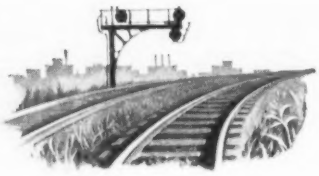
Whatever your brush problem



Line?



Roadside?



Right-of-way?

WEEDONE can solve it!

With the right background—Chemical control of weeds and brush has developed along established lines of procedures and practices. Amchem initially pioneered the major advances in the field, has originated many of today's accepted procedures and products for efficient, economical weed and brush control. Your problems are in *experienced* hands when you hand them to Amchem!

With the right approach—Amchem's corps of weed and brush specialists are basically application specialists. Combining comprehensive theoretical and practical experience they are able to offer all industry a realistic approach to *any* weed or brush problem. These specialists have developed a variety of efficient weed and brush eradication programs over thousands of miles of line, roadside and right-of-way areas once choked and inoperable due to infestation.

With the right product—Amchem's tremendously diversified product line is your assurance that the right weed and brush killer is available and will be utilized for your specific problem. Weedone Brush Killers, for example, have been used in the field for years and proven eminently successful in eliminating weeds and brush wherever they are a problem. Why not bring your problems to Amchem?

Amchem and Weedone are registered trademarks of Amchem Products, Inc.

AMCHEM PRODUCTS, INC.
AMBLER, PA.

Please send me copies of your "Brush Control" brochure and full information on the uses of Weedone Brush Killers.

Name_____ Title_____

Company_____

Address_____

City_____ Zone_____ State_____

AMCHEM

WEEDONE

BRUSH KILLERS

another chemical development of

Amchem Products, Inc.

(Formerly American Chemical Paint Co.)

St. Joseph, Mo. • AMBLER, PA. • Niles, Calif.

Product Recorder

(*Continued from page* 94)

It is suited for watts and kw recording and multiple measurements. Carriage speed across the 10-in. scale is 2 sec. Chart speeds range from 1 to 30 in. per hr. Higher chart speeds and alarm switches are also available.

Weston Instruments Div, Daystrom, Inc, 614 Ferlinghuysen Ave, Newark 12, N. J.

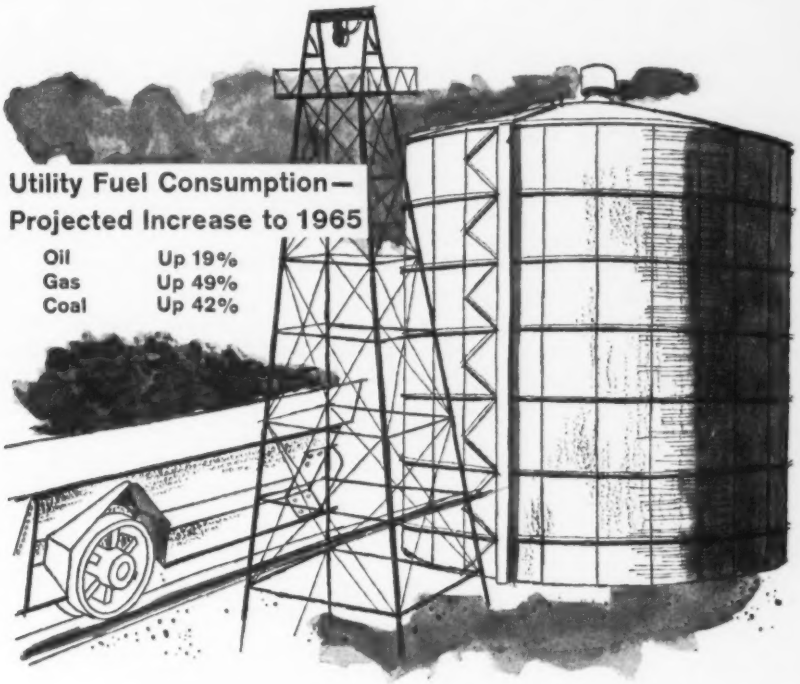
More New Products

Class F **wire enamel** withstands temperatures up to 175C. The insulation has high dielectric strength and resistance to Freon.—General Electric Co, Schenectady 5, N. Y.

Spray-can **chemical solvent** quickly cleans electric motors and plant equipment. Called "Swish Elektrokleen," the unit has a special nozzle for long-ranged, concentrated drenching spray. — Montgomery Chemical Co, Jenkintown, Pa.

Small, compact NEMA Size 4 **starter** has trip-free melting alloy overload relays with unit-construction thermal units. The units are also available with adjustable bimetallic overload relays with hand and automatic reset.—Square D Co, 4041 N Richards St, Milwaukee 12, Wis.

Improved 600 cfm **air compressor** driven by turbo-charged diesel engine has improved performance under extreme altitude and climatic conditions.—Schramm, Inc, 900 E Virginia Ave, West Chester, Pa.



Fuel Plans: The Next Five Years

Report on
Fuel Outlook

The electric utilities will consume 40% more fuel by 1965, keeping the nation's fossil fuel salesmen busy scribbling orders for the world's fastest-growing fuel market. Based on a McGraw-Hill survey of some 200 electric utilities (representing close to 80% of total national fuel burn) the following pattern will emerge in the years through 1965:

- **Gas will post the fastest rate of growth**—9% per year— for a total increase of 31 million (coal equivalent) tons.
- **Coal demand will continue to dwarf all others** and will increase at a rate close to gas—7% per year—with total demand surging 71 million tons.
- **Residual oil, slow-poke of the group, will show a 3% per year gain;** an increase of 4 million (coal equivalent) tons.
- **Coal will retain its present tight grip** of 66.6% of total industry fuel burn—thanks to oil's slower growth. The gainer, gas, now 25.6% of the industry's boiler fuel purchases, will rise to 26.6%. And oil, outlapped, will slip from its current 8.0% position to 6.8% by 1965.

The study, drawn from the most reliable source of all—the utilities themselves—was complied by *Keystone Coal Buyers Manual*, a McGraw-Hill annual. Keystone General Manager, Joe Forsythe, admits his figures represent only the composite views of 200 utilities he surveyed this January, and in November and December of last year. He has made no provision for major changes that could occur in the next five years—changes in political developments, the world economy, U. S. oil import quotas, a Canadian decision to export

PMC FIELD PROVEN CONTROL

OVER 250,000 INSTALLATIONS!

A complete line of precision photoelectric controls & accessories for outdoor lighting.

PRECISION MULTIPLE CONTROLS., RIDGEWOOD, N. J.

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CANTON, OHIO
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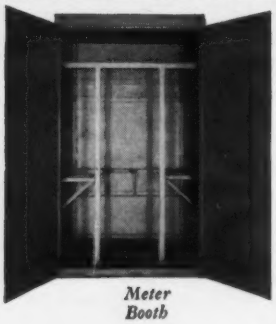
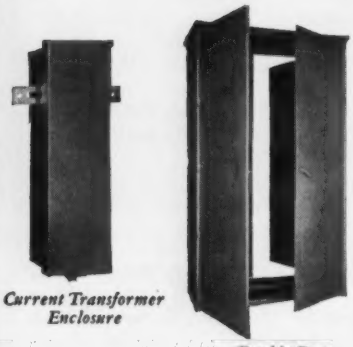


Meter Booth



Current Transformer Enclosure

Double Door Enclosure

Tractor-Shovel . . .

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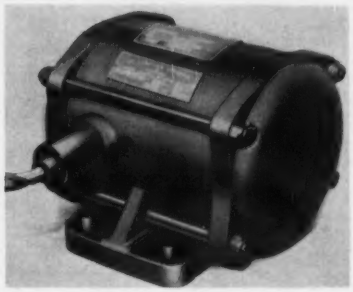

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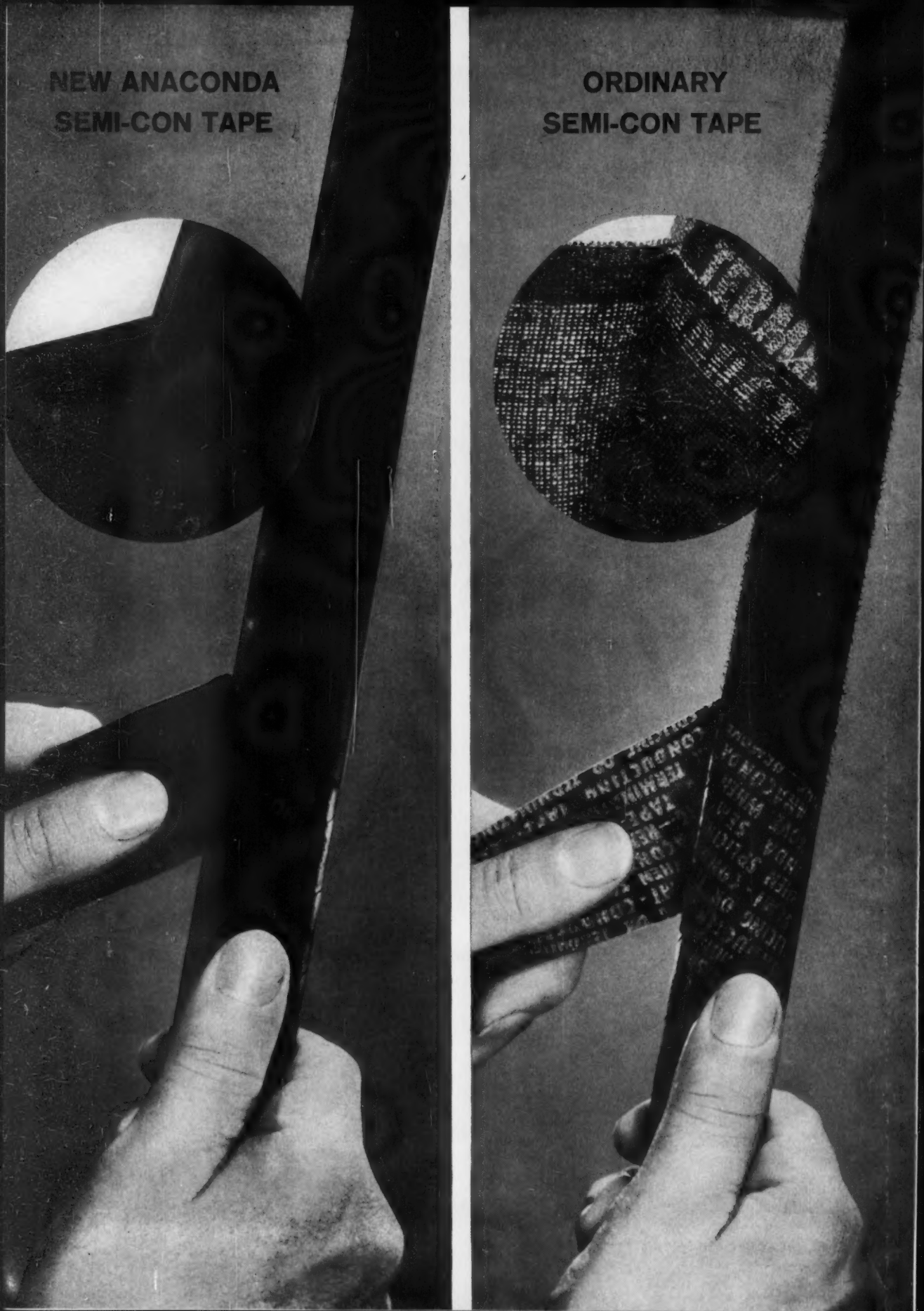
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ORDINARY
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60239

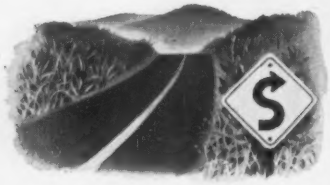
ASK THE MAN FROM

ANACONDA®

FOR DURASHEATH® CABLE

Whatever your brush problem

Line?



Roadside?

Right-of-way?

WEEDONE can solve it!

With the right background—Chemical control of weeds and brush has developed along established lines of procedures and practices. Amchem initially pioneered the major advances in the field, has originated many of today's accepted procedures and products for efficient, economical weed and brush control. Your problems are in *experienced* hands when you hand them to Amchem!

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Amchem and Weedone are registered trademarks of Amchem Products, Inc.

AMCHEM PRODUCTS, INC.
AMBLER, PA.

Please send me copies of your "Brush Control" brochure and full information on the uses of Weedone Brush Killers.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

AMCHEM

WEEDONE

BRUSH KILLERS

another chemical development of

Amchem Products, Inc.

(Formerly American Chemical Paint Co.)

St. Joseph, Mo. • AMBLER, PA. • Niles, Calif.

Product Recorder

(*Continued from page* 94)

It is suited for watts and kw recording and multiple measurements. Carriage speed across the 10-in. scale is 2 sec. Chart speeds range from 1 to 30 in. per hr. Higher chart speeds and alarm switches are also available.
Weston Instruments Div, Daystrom, Inc, 614 Ferlinghuysen Ave, Newark 12, N. J.

More New Products

Class F **wire enamel** withstands temperatures up to 175C. The insulation has high dielectric strength and resistance to Freon.—General Electric Co, Schenectady 5, N. Y.

Spray-can **chemical solvent** quickly cleans electric motors and plant equipment. Called "Swish Elektrokleen," the unit has a special nozzle for long-ranged, concentrated drenching spray. — Montgomery Chemical Co, Jenkintown, Pa.

Small, compact NEMA Size 4 **starter** has trip-free melting alloy overload relays with unit-construction thermal units. The units are also available with adjustable bimetallic overload relays with hand and automatic reset.—Square D Co, 4041 N Richards St, Milwaukee 12, Wis.

Improved 600 cfm **air compressor** driven by turbo-charged diesel engine has improved performance under extreme altitude and climatic conditions.—Schramm, Inc, 900 E Virginia Ave, West Chester, Pa.

With

SUPERIOR

SD CONTROL

CABLE...

QUALITY

comes in a small package!

For the maximum number of control circuits in the least amount of space... top quality SUPERIOR SD Control is the answer.

Overall diameters are reduced by as much as 20% to 35% *without* any sacrifice of reliability in performance!

High quality polyethylene, armored with tough nylon, insulates the flexible, stranded conductors. Color-coding to meet your requirements. Non-hygroscopic tape covers the core... and the smooth, neat jacket of durable polyvinyl chloride has excellent resistance to oils, alkalies and solvents. Conduits are not needed.

For performance and economy... for more circuits in less space... use high quality SUPERIOR SD Control Cable.

For complete information and prices, write

SUPERIOR CABLE

SUPERIOR CABLE CORPORATION

Hickory, North Carolina

4710

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For additional information on new products, supplies, and services in this issue, the Manufacturers Editor of Electrical World offers his facilities. Check items in which you are interested in list below.

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General Mills.....Computer ☐
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Hough .....Tractor-Shovel ☐
Wellman .....Vibrator ☐
Weston.....Product Recorder ☐

OTHER

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Manufacturers Editor
Electrical World
330 W. 42nd St.
New York 36, N.Y.

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Reference ..... ☐
Specs ..... ☐
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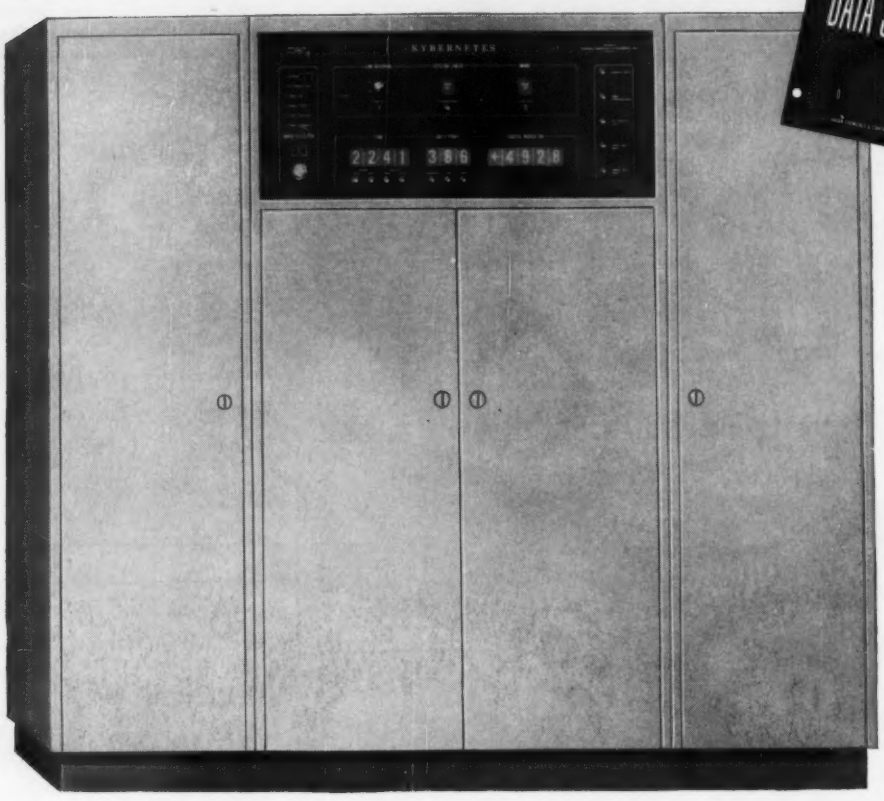
APRIL 11, 1960

For complete information on the many features of the Hagan Kybernetes Series 2000 data processing unit—phone or write for Bulletin MSP-161



Hagan Kybernetes® Data Processing Unit Offers...

ACCURACY • LOW MAINTENANCE • MANY EXTRAS

Hagan Kybernetes Series 2000 data processing is an all-electronic system for logging, computing and alarm scanning. Designed around modular chassis, with similar types interchangeable, the system includes linearization, square root extraction, AC to DC conversion, multiplication, division and digital alarm comparison.

Here are some of the unique features of the Series 2000:

CONTINUOUS ALARM SCANNING—Alarm scanning does not stop during logging, trend logging or visual display of any variables.

HIGH SPEED A to D CONVERSION—This feature allows parallel functions such as computing and integration to proceed without interfering with alarm scanning and logging.

HIGH RELIABILITY—Modular construction of plug-in chassis provides reduced down time and no inventory problems.

HIGH ACCURACY—Simplified design and highest quality components provide an overall accuracy of ±0.1% of full scale.

PINBOARD PROGRAMMING—Pre-wired pin board makes selection of operational characteristics, or changing them, extremely simple.

HAGAN

CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA

HAGAN DIVISIONS: CALGON COMPANY—HALL LABORATORIES—BRUNER CORP.

Westinghouse

ELECTRIC CORPORATION

TRANSFORMER DIVISION

April 14, 1960

PHONE: DI-6-5511
469 SHARPSVILLE AVE.
SHARON, PENNA.

Check NEMA for new possible standard

Jw — send this letter to advertising dept. for trade ad material

Mr. R. M. Ray, Sales Manager
Distribution Transformers

Bob,

HL - 65° Transformer

At last we are ready to let you announce the Hi-Load 65° transformer -- the design you've been after to allow higher transformer loading at reduced operating costs.

When we came out with all of our propaganda in 1958 about the bonus overload capacity of Westinghouse transformers, we knew that this heavier loading would not affect transformer life expectancy because of our inherent design and INSULDUR insulation. But the advantages of transformer overloading had to be balanced against the operating losses from these higher loads.

(W) Red Lake Stony

This new Hi-Load 65° will utilize a SUPER-INSULDUR insulating system. SUPER-INSULDUR allows our engineers to work transformer materials harder (65°C rise) with better transformer life expectancy. As you know, SUPER-INSULDUR supersedes regular INSULDUR and will be available in all new Westinghouse pole-type transformers.

The Hi-Load 65° will use a new high temperature insulating oil -- with higher flash and boiling point. This new oil is completely compatible with existing transformer insulating oil.

(W) Exclusive

These two important insulating breakthroughs by Westinghouse research make practical a significant reduction in loss ratio. The new HL - 65° with a two to one loss ratio has a lower total loss at any load above nameplate rating than does the industry accepted transformer with a 3 to 1 ratio. This reduction in copper to iron loss ratio makes possible reduction of 14 to 20% in impedances.

Show AIEE bursting strength comparison

Based on the calculations Art Lockie has worked out, our customers can now save from $3 to $12 annually with each new Hi-Load transformer following recommended heavier loading practices.

You can offer the new Hi-Load 65° in 25 kva ratings (2400, 4800, 7200, 7620, 8050 V) to progressive customers on a limited supply basis. Other ratings and voltage classes will follow shortly.

This should be the new transformer that will provide new standards for the industry, offering our customers more usable kva at the lowest capital investment.

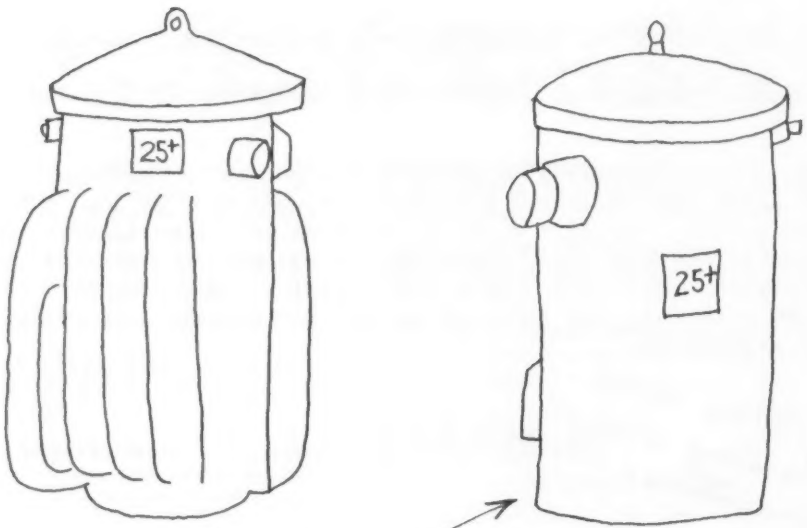
Sincerely,

WESTINGHOUSE ELECTRIC CORPORATION

R. P. Wagner, Marketing Manager
Distribution Transformer Department

RPW:mls

Use this data for art in ad.



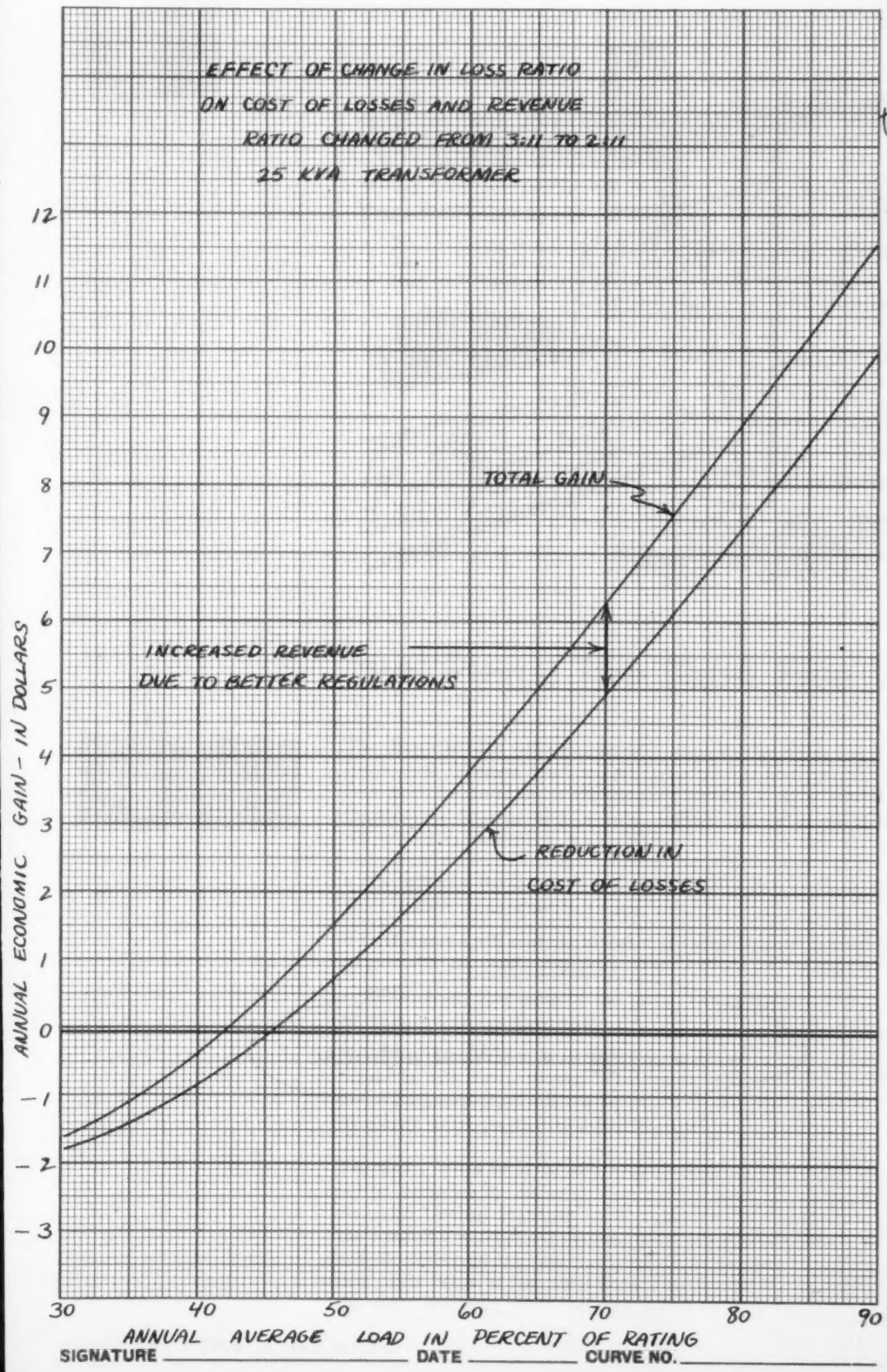
Note HL-65°
Has no cooling fins
means lighter weight

YOU CAN BE SURE... IF IT'S Westinghouse

FORM 1768H

WESTINGHOUSE ELECTRIC CORPORATION

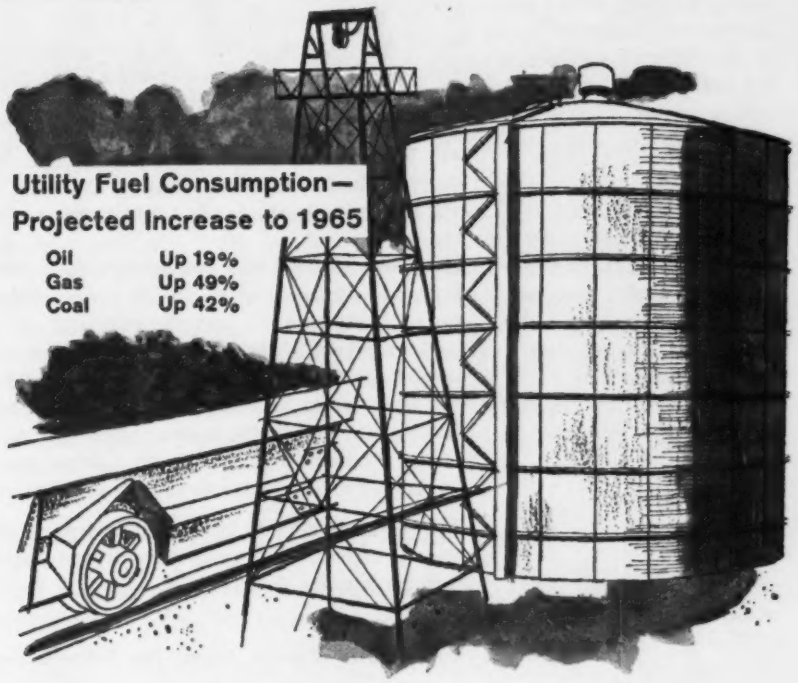
CURVE NO. _____



This is the meat of the savings story — play up big in ad

SIGNATURE _____ DATE _____ CURVE NO. _____

YOU CAN BE *SURE*... IF IT'S Westinghouse



Fuel Plans: The Next Five Years

Report on
Fuel Outlook

The electric utilities will consume 40% more fuel by 1965, keeping the nation's fossil fuel salesmen busy scribbling orders for the world's fastest-growing fuel market. Based on a McGraw-Hill survey of some 200 electric utilities (representing close to 80% of total national fuel burn) the following pattern will emerge in the years through 1965:

- **Gas will post the fastest rate of growth**—9% per year— for a total increase of 31 million (coal equivalent) tons.
- **Coal demand will continue to dwarf all others** and will increase at a rate close to gas—7% per year—with total demand surging 71 million tons.
- **Residual oil, slow-poke of the group, will show a 3% per year gain;** an increase of 4 million (coal equivalent) tons.
- **Coal will retain its present tight grip** of 66.6% of total industry fuel burn—thanks to oil's slower growth. The gainer, gas, now 25.6% of the industry's boiler fuel purchases, will rise to 26.6%. And oil, outlapped, will slip from its current 8.0% position to 6.8% by 1965.

The study, drawn from the most reliable source of all—the utilities themselves—was complied by *Keystone Coal Buyers Manual,* a McGraw-Hill annual. Keystone General Manager, Joe Forsythe, admits his figures represent only the composite views of 200 utilities he surveyed this January, and in November and December of last year. He has made no provision for major changes that could occur in the next five years—changes in political developments, the world economy, U. S. oil import quotas, a Canadian decision to export

gas, world vessel rates, railroad freight rates, or even the competitive in-fighting amongst the fuel producers themselves.

Conclusion of the study: Coal demand will increase in every single area, even in the highly competitive New England and Middle Atlantic regions. Oil, which will lose its position in coal-competitive areas, will nevertheless make some gains in gas-competitive areas. For gas, big gains will be concentrated in the non-coal regions—except for one, the West North Central. But there, coal's rate of growth will edge ahead of gas, reversing a 15-year trend. Gas will also register gains in the Pacific and West South Central regions; the states of Idaho, Arizona, Nevada, and New Mexico in the Mountain region; and in Florida in the South Atlantic region.

The most intense fuel competition is developing in these areas: (1) New England-Middle Atlantic coastal areas, where foreign residual and pipeline gas enter the scene to compete with coal; **(2)** Florida, where gas is swallowing up oil markets in the southern part of the state, and coal is invading the oil markets in the northern part of the state; **(3)** California, where both oil and gas struggle for supremacy in a fast-growing market; **(4)** The West North Central and Mountain regions, where gas competes with coal; and **(5)** Some of the Southern and East South Central states where, in almost 100% coal territory, gas has made contracts with a few utilities.

The Keystone survey, which included projections of fuel use through 1965 as well as expansion of generating capacity through 1962, shows the following regional patterns developing (*gas and oil figures in coal-equivalent tons*).

New England: Coal Widens Lead; For Gas—Crumbling Hopes

New England's competitive edge now begins to shift solidly to coal, with projections showing a gain of 40%—over 2 million tons—by 1965. Oil too will gain, but by only 10%, or less than ½-million tons. The gas invasion, highly publicized in 1954, reached a high of less than 5% in 1958, suffered a setback in 1959, and shows still further declines ahead to 1965. New fuel-burning units going on the line through 1962 also show this trend reversal, with six coal-fired units, and only two coal-oil units. Three utilities, Connecticut Light & Power, Public Service of New Hampshire, and New England Power, account for a total expected increase in coal burn of more than 2 million tons.

Middle Atlantic: Coal Shrugs Off a Bad Year, Eyes Big Gains

Fuel competition here is confined almost entirely to coastal areas. Both oil and gas made major advances in 1958, and again in '59. But the trend will reverse, shifting back to coal this year. Consolidated Edison, Public Service of New Jersey, Philadelphia Electric, Atlantic City Electric, and Long Island Lighting define the areas of hottest competition. Four out of five expect declines in oil use (averaging 20%). Two companies show declines in gas, while another will level off, resulting in a 20% decline in gas. Coal will make up these losses, as well as firing most of the new plants. Projections show a 5 million ton increase for coal by these five utilities by 1965. Of new units scheduled, three will be coal-fired, one coal-oil, three coal-gas, one oil (a peaking unit), and one nuclear plant.

Inland Pennsylvania expects an expansion of about 25% by 1965, all, of course, on coal—about 3 million tons more. Next door, inland New Jersey and upstate New York project no gains for coal. Upstate New York will, through 1965, be getting its expansion requirements from the St. Lawrence hydro developments. Inland New Jersey will be shifting part of its needs to new, modern stations across the Delaware in Pennsylvania.

East North Central: Coal's Backyard and Biggest Market

40% more coal—a 27 million ton increase—will fire utility boilers in this region by 1965. Coal demands of at least 10 utilities will increase by more than 1 million tons. Three other utilities, all producing power for nuclear fuel manufacturing plants, have reached their capacity of about 9 million tons-a-year, and plan no further expansion. There is only one area of gas competition; in Chicago and along the lake shore as far as Toledo. About 70% of this gas fires Commonwealth Edison boilers. Last year Commonwealth Ed purchased 700,000 more tons of gas, a 50% increase in one year. But in 1960, its gas use will fall off 1 million tons.

This is the first coal-gas competitive area in the U. S. where constantly increasing gas prices have finally reached or passed coal's more stable price level. Since 1954, gas prices rose from 18.4¢ per million Btu to 24.2¢ per million Btu in 1958, with another increase to about 25¢ last year. Meanwhile, coal prices fell from 25.6¢ in 1951 to 24.9¢ in 1958. One small utility, Superior Water, Light & Power, shows a gradual shift from coal to gas; most other gas-users show a leveling-off. Forty new units are to go on the line by 1962. Thirty-six will be coal-fired; one (Commonwealth Edison) will burn coal and gas, while three others will be nuclear powered—one in Illinois, one in Michigan, and one in Minnesota.

South Atlantic: All Fuels Make Impressive Gains

South Atlantic utilities will burn 70% more oil, 45% more gas, and 45% more coal by 1965. The region is split into three distinct competitive areas. The northern tier (Delaware, Maryland, District of Columbia, Virginia, West Virginia, and North Carolina) are almost 100% coal-burners. They burned 21 million tons of coal in 1959 and expect that figure to increase 50% by 1965. In this area there are only three publicly owned utilities that use some gas, with one municipal, Danville, Va., almost 100% on gas. Two naval installations burn about 50,000 tons of oil, each.

Gas, however, enjoys about 35% of the market in South Carolina and Georgia, but projections show gradual declines. Coal shows a projected increase of about 1 million tons, despite the fact that some future electricity will be imported into Georgia from Alabama.

The third competitive area, Florida, is split into two parts: **(1)** The South, with gas moving into oil territory. Here, 1959 gas burn was over 2 million tons, or almost 30% of the state fuel burn. This year, gas will get a tremendous boost to 4 million tons, but with little further gains through 1965. Oil use fell off almost 1 million tons last year, and will decline further this year. But oil's outlook from 1961 to 1965 is much brighter; a 70% increase, or almost 3 million tons. **(2)** Northern Florida is the second competitive area, with Tampa, Electric and Gulf Power increasing coal burn by 50% in 1959, and estimating a further 1 million ton increase by 1965. Eight units to go on Florida lines by 1962 confirm these trends, with two gas-oil units in the south, two coal units in the north, and four oil units.

East South Central: Sharply Divided

By fuels, this region is split. Kentucky and Tennessee are almost 100% coal burners, and Alabama over 90%. Some gas is used by Alabama Power, Louisville Gas & Electric, and the City of Memphis. The first two project a continuing decline for gas, while Memphis expects a steady supply.

Coal gain for the region is projected at 55% by 1965, a 14 million ton increase. TVA will do more than its share, accounting for the biggest coal tonnage increase in the nation, with a projected 7 million ton advance, and this by

1963, with no figures available beyond. The newly formed Southern Electric Generating Co expects to burn 2½ million tons by 1965, most of which will be dug from its own coal mines.

Mississippi, of course, is almost 100% on gas, the lone exception being the City of Greenwood, which burned a small amount of coal last year and has ordered gas-coal firing for its new unit. Here, a 30% increase for gas by 1965 will add about 400,000 tons—about enough to balance gas declines in the three coal burning states.

New units going on the line through 1962 bear out this trend, with eleven new coal burning units (including two 500 Mw and one 600 Mw) scheduled for Alabama, Kentucky and Tennessee, and two gas burning plants in Mississippi.

West North Central: Coal and Gas Run Neck-and-Neck

Gas has made advances here in almost every year since 1946, nibbling away at coal's share, until last year both fuels enjoyed a roughly equal piece of the market. The regions' utilities expect to burn 40% more gas and 50% more coal within five years, which will begin to give coal an edge. There is one exception to this standoff pattern of growth. Missouri Public Service, which burns almost all gas under its boilers, has two coal burners going on the line this year and next. This will halve its gas use by 1964, but by 1965 its gas burn will again hit 1959 totals.

West South Central: Where Gas Is King

This is the backyard of the gas industry. The story is simple; gas will gain 60%, for a 15 million ton increase by 1965. This gas monopoly is in no way threatened by the few thousand tons of coal burned at Raton, and some in Texas (which does not appear in official records because this power generation is considered captive). Oil, however, may gnaw at gas's position. For the first time, dual-fired units, gas and oil, are to go on line, one in Louisiana and four in Texas, with total capacity of 676 Mw. This is one of the few areas where it appears oil may make some competitive gains.

Mountain: Heavy on Gas. For Oil, a Nibble

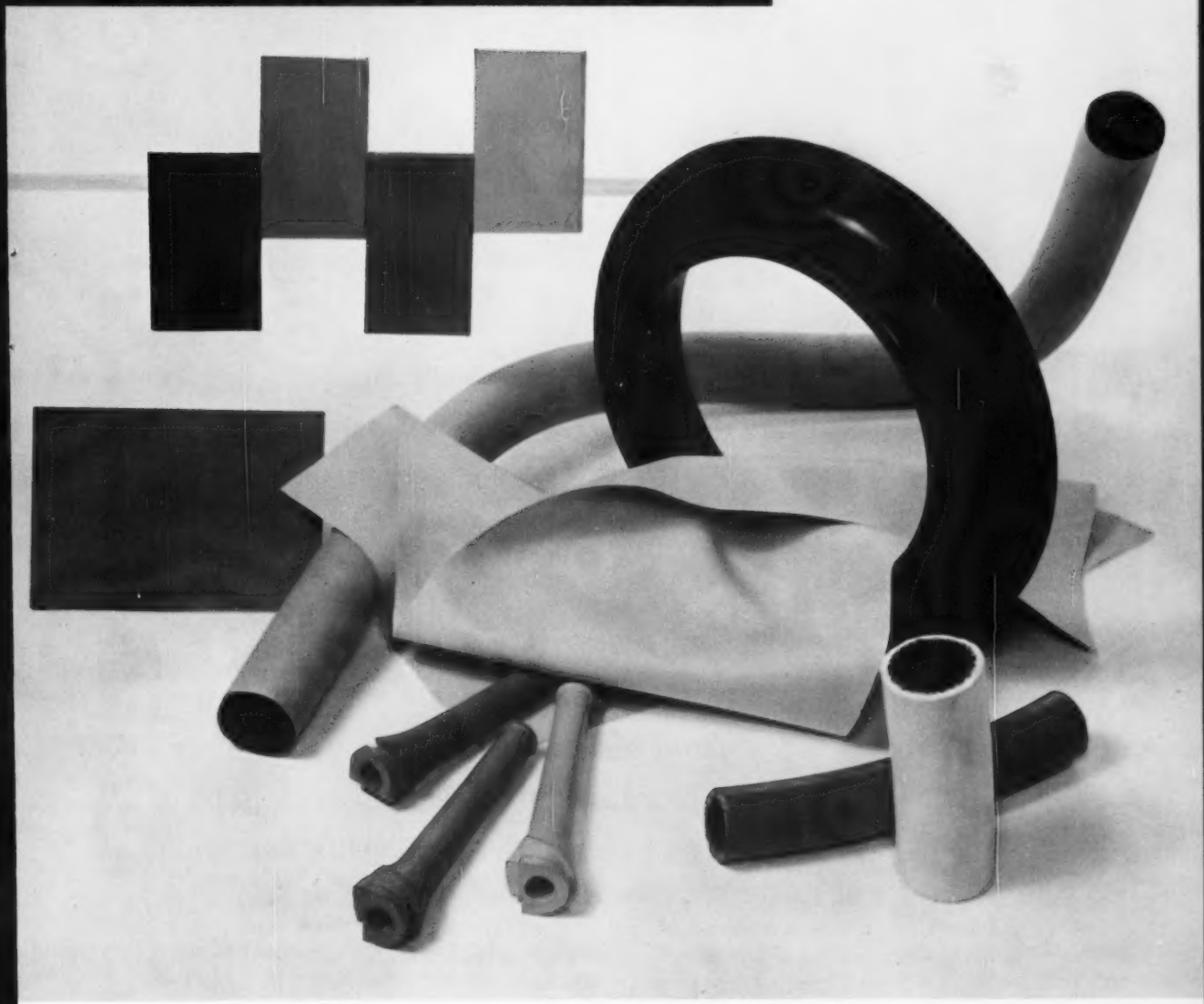
Through the fifties, gas and coal have divided this market about 70-20, with oil (pitch) enjoying one refinery-generating plant pipeline business of about 500,000 tons a year. The northern states, Montana, Wyoming, Colorado, and Utah are the gas-coal burners. The southern tier, Nevada, Arizona, and New Mexico, are the all-gas burners. Both gas and coal will make big gains, 110% each, through 1965, which will maintain the status quo at 70-20. New units on order conform to this pattern except in Arizona and Nevada, where four dual gas and oil burning plants, totaling 396 Mw, will be installed by 1962. Added to Texas and Louisiana, this gives oil a first-break into four states with a solid record of burning almost 100% gas.

Pacific: More Gains for Gas at Oil's Expense

This is the battleground for oil and gas. The record shows gas has increased its share of the market from 19% in 1946 to 69% in 1959, while oil has declined from 77% to 32%. Projections show gas burn will increase by 60%, or about 7 million tons, by 1965, while oil shows only a 30% gain, an increase of about 1.5 million tons. Los Angeles Department of Water & Power will burn about 70% more gas by 1965, an increase of 1.1 million tons, but plans to boost its oil burn by only 34% over the same period.

Naugatuck PARACRIL OZO

THE OIL-RESISTANT, OZONE-RESISTANT NITRILE RUBBER



...tough, oil-proof, weather-proof and **colorful, too!**

The samples above should begin to give you some idea of the endless color possibilities in ozone-resistant rubber products made of new PARACRIL® OZO. Now you can give your product color that *sells*... color that identifies for coding wire and cable jacketing... color that blends or *contrasts*... color that works in a hundred ways. And you can give your product other superior properties, too.

Along with color, new weather-resistant PARACRIL OZO gives you a combination of high abrasion resistance, oil resistance, flex life and other valuable rubber properties far surpassing conventional weather-resistant rubbers.

Cast a new eye on the rubber product you make or buy. See the difference color makes. See your Naugatuck Chemical Representative or write the address below for full information on PARACRIL OZO and the advantages it offers.

Naugatuck Chemical

Division of United States Rubber Company Dept. A Elm Street Naugatuck, Connecticut

Rubber Chemicals · Synthetic Rubber · Plastics · Agricultural Chemicals · Reclaimed Rubber · Latices · CANADA: Naugatuck Chemicals Division, Dominion Rubber Co., Ltd., Elmira, Ontario · CABLE: Rubexport, N.Y.

"Gold Medallion Home developments like Lincoln Park help greatly to level summer and winter peak demands"...

says W. T. RICHARDS, *Vice-President—Sales, Indianapolis Power & Light Company*

"Electric home heating is a desirable and profitable business. But aside from that, all progressive electric utilities must promote electric home heating to maintain proper balance between summer and winter peak demands.

"Electric home heating assures maximum utilization of system facilities, and also helps a utility to maintain existing electric rates in spite of the inflationary spiral.

"Here in Indianapolis, our favorable electric rate encourages electrically heated homes like the Gold Medallion Homes*, extensively built in our Lincoln Park and Candlelight Village developments.

"In these developments, Indianapolis Power and Light was very much impressed with the excellent cooperation that General Electric gave to our Gold Medallion Home promotion."

For an introduction to General Electric's program to promote Gold Medallion Homes in your area, write for booklet 45-015EW1.

***Gold Medallion Homes** equipped by General Electric are electrically heated . . . have at least four major appliances . . . Full Housepower—ample wiring, switches and outlets for present and future needs—and lighting planned for modern living.
Residential Market Development Operation, General Electric Co., Appliance Park, Louisville 1, Ky.

MEDALLION HOME LIVE BETTER ELECTRICALLY by GENERAL ELECTRIC
WITH LIGHT FOR LIVING HEATING and COOLING KITCHEN and LAUNDRY FULL HOUSEPOWER

Progress Is Our Most Important Product

GENERAL ELECTRIC

Nashville Relights Whole City in $2.4 Million Program

EARL E. PARKS, Manager, Lighting & Heating Dept, Nashville Electric Service, Nashville, Tenn.

FAULTY PHOTOELECTRIC CONTROLS are replaced with good one. The bad controls are taken back to the shop for repairs

Poor street lighting can run up a tremendous bill in terms of costly accidents, broken bones, and even loss of life. Insurance rates skyrocket, crime flourishes, and retail business suffers when any city "walks in darkness."

An extensive five-year street lighting program has brought Nashville, Tenn., from a city that "walked in darkness" to a point where it may well be "America's Best Lighted City."

In 1953, forward-looking city council members, headed by Mayor Ben West, approached Nashville Electric Service concerning a street lighting modernization program. There was growing concern over the increase in traffic caused by high post-war automobile registrations, night crime, and diminishing nighttime downtown business.

At that time there were about 6,300 small, outdated incandescent street lights scattered ineffectually around the city. They supplied only "interrupted darkness." In fact, Nashville had had very little modern street lighting installed since the turn of the century.

NES Agrees to Build System

Nashville Electric Service agreed to build and maintain the modern street lighting system. Expenditures were not to exceed $600,000 per year. The annual rate charged off to the city was cost—or about 8% of Nashville Electric Service's investment—plus eight mills per kwhr. This contract is good for 50 years.

The new modern lighting system consists of more than 11,000 mercury-vapor and incandescent luminaries on all 425 miles of city streets. It cost nearly $2.4 million.

Cost is covered in the taxes which the city uses to pay the utility. It runs less than $3 per person annually. This compares with street maintenance and repair costs of nearly $8 per person. Even street cleaning costs Nashville residents almost $1 per person per year.

Maintenance costs are kept low by group re-lamping. Although mercury lamps have a greater life than 27 months, we replace them at this time. This is done for two reasons: first, the maintained lumen output for the 9,000 hr burning time is over 90% of what it is initially; and second, by group replacement, we reduce the spot replacements to about 5%.

Controls Not Repaired 'On the Spot'

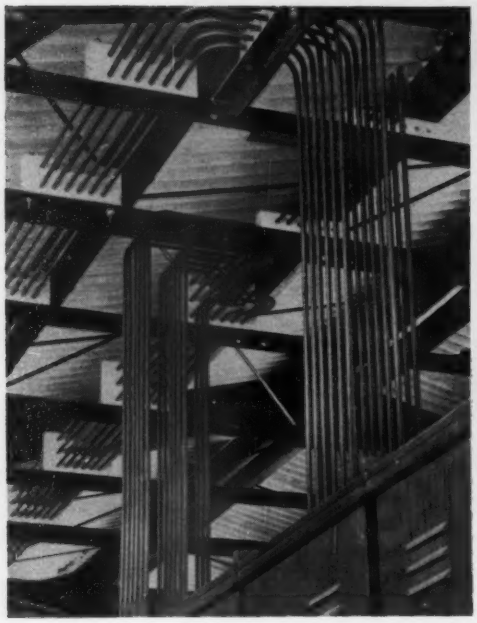
Instead of trying to repair photoelectric controls right on the spot, a faulty one is replaced with a good one and the bad one brought back to the shop.. Tubes are replaced, the unit recalibrated and put on a stand-by basis as a relief for later use.

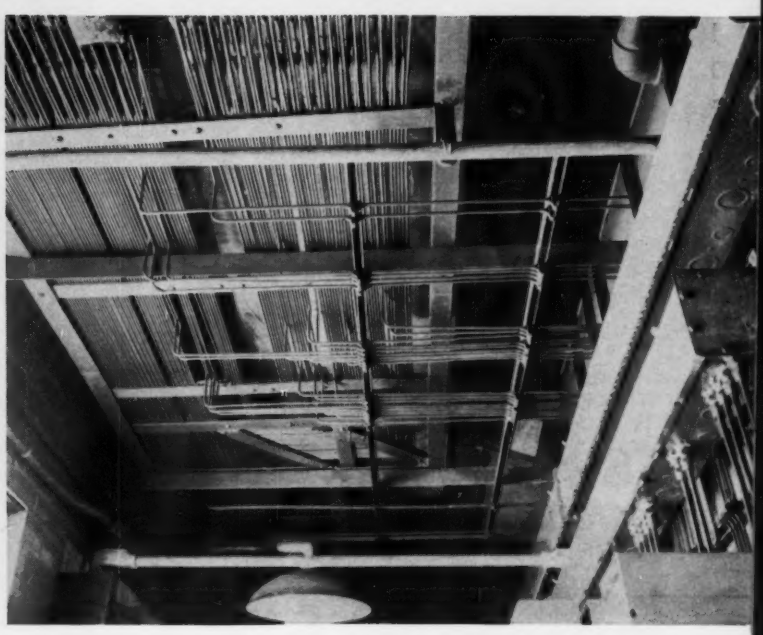
Each year, as the photoelectric controls became older, we encountered an increasing number of failures due to faulty controls. For some three years, the controls used for mercury lighting have been replaced every time the lamps were changed. This has proven very successful, as has our group lamp replacement program.

To replace the incandescent lamps, our service area is divided into six sections. Every year, the lamps in each section are replaced twice, thus one section is covered every month of the year.

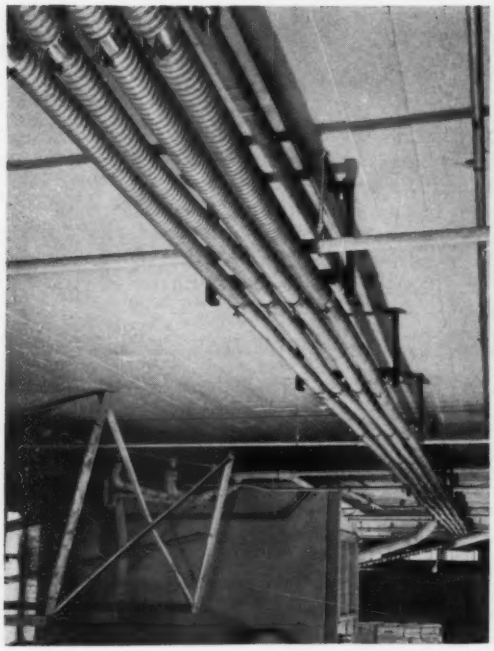
We arbitrarily set up a schedule of two years for

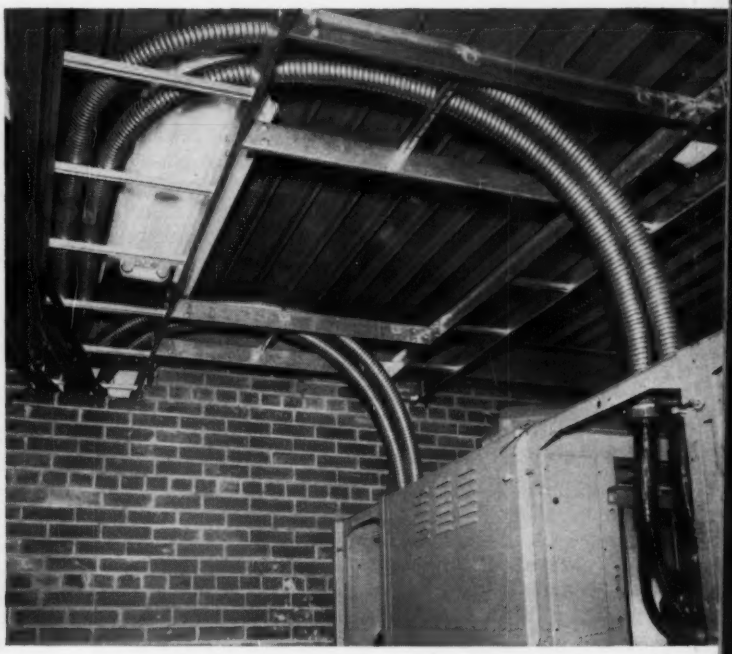
(*Continued on page* 114)



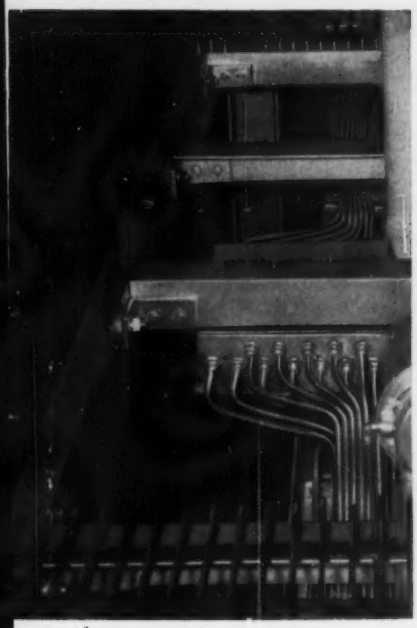


the right combination for





ONLY GENERAL CABLE MANUFACTURES BOTH TYPE MI AND INTERLOCKING ARMORED CABLES. CONTACT YOUR NEAREST GENERAL CABLE SALES OFFICE FOR FULL INFORMATION AND SPECIFICATIONS.



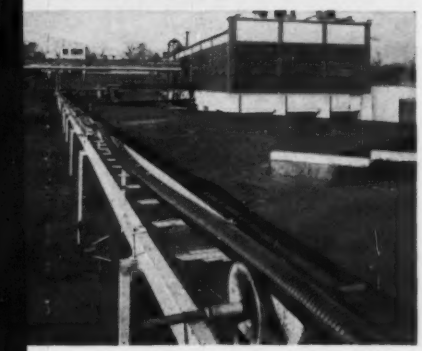
type mi cable

for power distribution, control and lighting circuits

TYPE MI CABLE has solid copper conductors and sheath separated by highly compressed inorganic insulation! Just about indestructible, yet it trains easily over and around obstructions. Naturally it needs no protection: just train it and terminate it. MI is compatible with all other wiring systems. It is completely resistant to moisture, age, nearly all chemicals, temperatures up to 185°F with standard terminations, 482°F with special terminations; and it is approved for use in hazardous areas. It will last forever.

industrial power

Type MI Cable and Interlocking Armored Cable work together to lower installation costs, minimize space requirements, provide maximum flexibility and accessibility in your cable systems.



inter-locking armored cable

for feeder circuits

GENERAL CABLE'S Interlocking Armored Cable combines flexibility with the mechanical protection normally afforded by metallic conduit, yet has the same current rating as cable in free air. It can be trained to fit the contours of buildings and surrounding equipment and provides a neat, compact installation. It is available in bronze, aluminum and steel and may be applied over most cable insulations in the voltage ranges recommended by industry standards. Protective coverings are available to combat environmental conditions which might cause pitting or corrosion of the interlocking armor.

GENERAL CABLE CORPORATION
65 Offices and Distributing Centers Coast-to-Coast

730 Third Avenue,
New York 17, N. Y.

for quality and service specify... **GENERAL CABLE**

(*Continued from page* 111)

replacing all photoelectric controls. To accomplish this, all of the six sections are divided into four parts, and every time lamps are replaced in any section, the controls in one-fourth of that section are also group replaced. The initial phase will require two years and thereafter every control will be regularly removed for tests and calibration after two years service.

This program was started June 1, 1959, and while only one-fourth of the individual controls have been serviced, we are convinced from results obtained so far that there will be a marked decrease in spot replacements. Our superintendent of street lighting maintenance has said that by group replacing both lamps and controls, he feels sure that we are eliminating the necessity for adding at least one service truck and quite possibly two.

When the relighting began, it was a street lighting man's dream—a chance to relight a city from scratch and do a good job of it. There was no worry about integrating with an old, existing system.

ALL 425 MILES of Nashville were relighted to IES standards in a modernization program which cost nearly $2.4 million. Maintenance costs are kept low by group re-lamping

Shortly after the program began, the city sold its old system in its entirety to NES so the utility might assure operation while replacing it.

The downtown area and traffic streets came in for immediate attention. This downtown section—about 9.4 miles of streets—was originally lighted with 3,000 and 10,000-lumen incandescent fixtures which provided spotty and inadequate illumination.

Today, 595 mercury-vapor luminaries provide an average of 1.6 foot-candles of illumination in the business district. This is well above the Illuminating Engineering Society's minimum standard of 1.2 ft-c for downtown areas. The thought was to have it as bright as possible because of the narrow, heavily traveled streets.

The luminaires are mounted on steel poles at a height of 30 ft. In the center of the downtown section they are only 75 ft apart and staggered, although this distance is increased to 120 ft in the outer part of this area. These units put the light on the pavement and sidewalks where it will do the most good. Old, ornamental units distributed light in all directions, including straight up, where it was of no use at all.

Traffic Volume Determined Precedence

Traffic streets were given attention in order of volume of travel. By the end of 1956, the modernization of these streets was 99% complete, and now all traffic streets are lighted to meet or exceed IES standards. Both 400-w mercury vapor and incandescent luminaires are in use on these streets. An average of 1.2 ft-c is maintained.

After all traffic streets having a count of 1,000 vehicles per day or more were lighted, residential streets came in for perhaps the biggest improvement. The 3,440 units—whose output averaged less than 2,500 lumens each—have been replaced by 6,300 modern, 6,000-lumen incandescent luminaires. They have an average maintained illumination of 0.3 ft-c, 50% above recommended IES standards for such neighborhoods. The units are spaced on an average of 250 to 300 ft apart and each unit has a separate photoelectric control.

The mercury units used on the traffic streets and the downtown area are served by a 240-v circuit, phase to ground, fed in two directions from one 10-kva transformer. There are normally between 20 and 24 units in each series turned on and off by a photoelectric control operating a multiple switch.

In addition to street lighting, Nashville Electric Service has lighted municipal parking lots, many alleys, the city hospital parking area, viaducts and bridges and even the streets in the city cemetery.

Program Has Been Effective

How effective has the lighting been? In 1952, the last full year before the modern street lighting was installed, 40% of all traffic accidents happened at night. In 1958, when the program was completed, only 29% occurred after dark. In 1952, 19 persons lost their lives in nighttime traffic mishaps; in 1958 only nine persons were killed in after-dark auto smash-ups, despite an increase from just under 100,000 to almost 150,000 registered vehicles in the county.

Although night crime statistics before the relighting are not available, armed robbery and other crimes of violence after dark have been reduced materially, according to a special report made by the police departments central records section.

The street lighting has "made our city a safe place to live in," said Police Chief Douglas E. Hosse. "I know from my past experience that it has made our streets safer to drive on and has helped a lot toward keeping our crime rate as low as it is."

Merchants reported one of the best nighttime pre-Christmas seasons in history in 1959. This helps create a better business climate for the city. Neighborhood business centers have benefited also from this freedom of night movement.

And, Mayor West summed up official thought with the statement, "New street lighting constitutes a municipal betterment which everyone can readily see. It certainly is the mark of a well operated community."

Consumers Power Promotes Aymond, Campbell

Alphonse H. Aymond Jr has been elected chairman of the board and chief executive officer of Consumers Power Co, and James H. Campbell has become president and chief operating officer.

Aymond, who is executive vice president, will be taking a position which has been vacant for several years. Campbell, who is senior vice president, will succeed Dan E. Karn, retiring as president.

Joining Consumers Power in 1947 as an attorney, Aymond became a vice president in 1955 and, in 1957, was appointed executive vice president.

Campbell joined the company in 1933. He was elected a vice president in 1950 and senior vice president in 1956.

AYMOND

CAMPBELL

Karn, with Consumers Power since 1915, will be retained as a consultant and chairman of the finance and budget control committee. He succeeds Justin R. Whiting, who will retire as chairman.

Kent Made Manager of New GE Section

Milton F. Kent has become manager of General Electric Co's newly-created Electric Utility Marketing Operation. His headquarters will be New York.

Kent has been with GE since he was graduated from the University of Maine in 1930 with a BS in electrical engineering. From 1936 to 1939 he served as an engineer on waterwheel generator design engineering and installation, and later as a design engineer for turbine generators.

Appointed central station engineer in 1948, Kent became application engineer in the New York office in 1950 and, in 1955, was promoted to manager of product sales. Since 1957 he has served as manager of apparatus product sales in GE's user industries sales department.

PERSONAL BRIEFS

George P. Mapes has been appointed manager of Weymouth Light & Power Co.

H. H. Trumbo, Columbus & Southern Ohio Electric Co, has received a Gustav Hirsch Award, along with **M. J. Leahy,** M. J. Leahy Co, and **Russell Canterbury,** Federal Pacific Electric Co, for their efforts in planning two Electrical Manufacturers' Expositions and for also introducing central Ohio's All-Electric Day.

Hubert H. Hexon has been appointed an assistant vice president of Commonwealth Edison Co. A change in the assignments of two vice presidents, as part of the utility's executive rotation policy has been made. **Murray Joslin,** vice president in charge of production, construction, and engineering, and **Thomas G. Ayers,** vice president of division operations and commercial activities, will exchange present assignments.

Royce B. Poland has been named supervisor of accounting at the Boston headquarters of New England Electric System. **Philip B. McCourt** succeeds him as supervisor of internal audits, and has been succeeded in the System's North Boston companies by **George H. Berry.**

Duke Power Co has made these promotions: **Douglas W. Booth** to assistant to **D. W. Jones,** vice president and supervisor of branches;

W. G. Wiatt to manager of the Spartanburg district; **A. M. Doolittle** to manager of the Anderson, S. C., district; **Dwight B. Moore** to assistant to the manager, Charlotte district; **J. Wesley Lewis** to assistant manager of the Durham district; **John F. Smith** to manager of the Kannapolis branch; and **Earl J. Norris** to electrical superintendent in the Gastonia district.

Pacific Power & Light promotions include: **Fred Morton** to district office manager at Kalispell, Mont.; **Lyle Gowdy** to an assignment in the treasury department; **Myron O. Neth** to district office manager in Pendleton; **W. Russell Gilman** to the audit staff in the general office; **Ted C. Creighton** to central Oregon district office manager; and **Don Lamb** to district office manager, The Dalles. **Charles E. Filbin** has been made residential sales director and **John Kohls** has been appointed district sales manager at Kalispell, Mont.

Morris D. Hooven has been promoted to consulting engineer in electric engineering department of Public Service Electric & Gas Co; **Robert I. Smith** to assistant to the chief engineer; **Donald W. Taylor** to electrical engineer; **Charles E. Parker,** assistant mechanical engineer; **John R. Bridgeman,** assistant cost engineer; **William G. Badgley,** construction superintendent; **E. Harold Erickson,** senior engineer, **James Nesmith,** senior engineer, **Edward N. Schwalje,** senior engineer, and **William E. Somers,** senior engineer, all in the electric engineering department. **Josiah A. Britton** has been made chief engineer, and **Mark R. Hontz,** master mechanic, at the Linden Generating Station.

Gordon Cavanagh promoted to product manager for Alumoweld at Copperweld Steel Co.

Ward L. Heath has been named purchasing agent for the Grand Rapids, Mich., plant of Kelvinator Division, American Motors Corp.

Combustion Engineering has appointed **Francis A. Schroff,** manager of corporate purchasing; and **Robert A. Niemi,** director of manufacturing. Thomas A. Ennis, secretary and counsel, has been elected a director.

William J. Lawless Jr has been appointed director of system and application engineering, and **C. Bruce MacKenzie,** manager of research and engineering information, at International Business Machines Corp.

William H. Happe Jr has been promoted to general manager, Princeton Division, Curtiss-Wright Corp.

Hubbard & Co has named **R. P. Bridges,** chief engineer, interrupting equipment, electrical research laboratory.

C. L. Christiansen, regional supervisor for electrical industrial sales, Dow Corning Corp, has resigned because of ill health. His future post will be vice president in charge of promotion for the The Golden Years Research and Development Center, an organization which will employ retired engineers, physicists, etc, to engage in research and development work, and to assist in the training of engineering graduates for large industries.

Samuel J. Rosch has retired as consulting cable engineer for Anaconda Wire & Cable Co.

Federal Pacific Electric Co has appointed **Ralph J. Weiger** industrial sales manager; **Armond J. Bisignani Jr** marketing manager, general products department; and **Walter H. Niemann** marketing manager for laboratory switchboards.

General Electric Co has made **Gerald A. Hoyt** general manager of the power transformer department, and **Oliver H. Winn,** general manager of the capacitor department.

G&W Specialty Co has named **Norman O. Kirkby,** general manager, and **Robert G. Poetsch,** sales manager.

I-T-E Circuit Breaker Co has named **W. T. Bolger,** manager, Special Products Division; **W. H. Edmunds,** manager, small Circuit Breaker Division; and **John M. Hottenstein,** manager, Kelman Division.

Philco Corp has named **Winton O. Etz,** section manager-integrated data systems, Government and Industrial Group; **R. J. Cherry,** merchandising manager of refrigeration, Consumer Products Division, **John J. Goldschmeding Jr,** merchandising manager-electric ranges and Citation custom appliances; **Albert Emanuel,** merchandising manager, home laundry equipment; and **Charles E. Dolberg,** director-systems management, Government and Industrial Group.

Westinghouse Electric Corp has made **Leo A. Hansen Jr,** Pacific Coast retail sales manager for the Lamp Division. **Fred O. May** succeeds him as lamp sales representative in San Francisco.

Robert M. Johnson has been made assistant manager, Foreign Sales Division, Fuller Co.

James S. Fidler has been elected treasurer and **William F. Collins,** secretary, of Revere Copper & Brass, Inc. **William Pearson** was elected assistant secretary and assistant treasurer. **A. E. McCormick,** treasurer and assistant secretary, retired February 1.

C. C. Martin, vice president of manufacturing, S&C Electric Co, has been named a director.

Harry E. Schneider has been appointed superintendent of the Engine Division at Electro-Motive Division, General Motors. He succeeds **Arthur A. Montes** who has been named general superintendent for Plant Two.

Edward L. Falls Jr has been promoted to executive assistant to the general manager of Motorola Inc's Communications Division.

A. Russell Young has been named assistant executive vice president and general manager of J. F. Pritchard & Co.

Allis-Chalmers Mfg Co has appointed three men to its motor and generator department: **Robert L. Linn, Richard M. Willets,** and **James W. Rhodes.** Linn and Willets will be assistant engineers, production coordination section; Rhodes will be an assistant engineer in the insulation section. **Dominick For-**

(*Continued on page* 118)

Now — Gould Stationary Batteries in Plastrite Jars withstand MORE HEAT THAN EVER WITHOUT DAMAGE!

They will not warp, bulge, or lose shape in the sun or extremely high room temperatures. The Plastrite Jars have 50% higher elongation characteristics, 15-30% higher resistance to heat distortion than other stationary battery jars.

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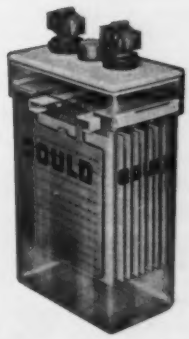

New Stationary Batteries in Plastrite Jars offer the same long life for which Gould has always been famous.

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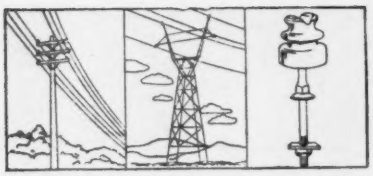

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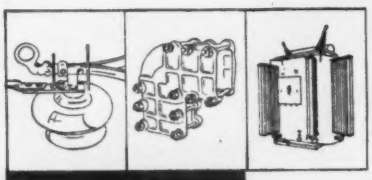
on all bolted assemblies



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tunato and **Maldon D. Laitinen** have been made assistant enginers in the nuclear power department's core engineering group. **Ole N. Ibsen** and **Charles J. Schwarz** have been assigned to the control department.

United Engineers & Constructors, Inc, has named **Gustave A. Heckscher** new business representative, and **J. Edward Sunkes,** director of purchasing.

Traction Service & Engineering Co has appointed **Seymour C. Lederer** chief of the Engineering Division.

Buffalo Forge Co has elected **Milford E. Reiner,** treasurer, to the board of directors.

August B. Kinzel, vice president-research, Union Carbide Corp, has been elected president of the Engineers Joint Council.

Yale Materials Handling Division, Yale & Towne Manufacturing Co, has named **Louis W. Jander,** general sales manager.

Ted Nemes has been made sales manager, Lighting Standard Division, Kerrigan Iron Works Co.

Stone & Webster Engineering Corp has appointed **John L. Niland** assistant engineering manager.

William N. Lucke has joined Philco Corp's Government & Industrial Division as systems manager. **John T. Morgan** has been made assistant to the merchandising manager-home laundry.

OBITUARY

G. M. Gadsby, 76, chairman of the board of Utah Power & Light . . . **Al De Groot,** 66, state treasurer of the National Assn of Power Engineers in Wisconsin . . . **Stewart Dickinson,** 63, manager of the Germantown office of the Philadelphia Electric Co. . . . **Frederick Manley Ives,** 80, board chairman and vice president of Boston Edison Co. . . . **Walter P. Eickmeyer,** 54, supervisor of maintenance and construction at Dallas Power & Light Co's plant department.

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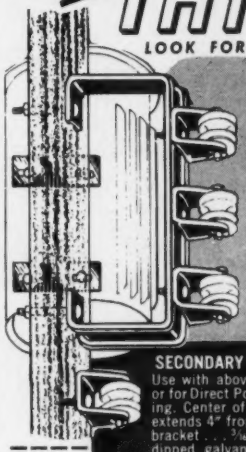

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Center of porcelain extends 12½" from pole..complies with regulations . . . Hot-dipped 2"x⅛" x ⅞" galvanized channel.

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Use with above Bracket or for Direct Pole Mounting. Center of porcelain extends 4" from back of bracket . . . ⅜"x3" hot-dipped galvanized with or without insulator

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FOR DIRECT POLE MOUNTING
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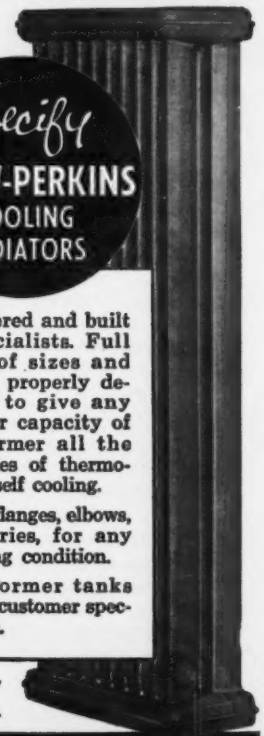

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Books

Books Recently Received

Symmetrical Components. By G. O. Calabrese. Published by The Ronald Press Co, 15 E 26th St, New York 10, N. Y. 464 pages, illustrated. Price $12.00.

Electrical Machines—Direct and Alternating Current, 2nd Edition. By Charles S. Siskind. Published by McGraw-Hill Book Co, Inc, 330 W 42nd St, New York 36, N. Y. 537 pages, illustrated. Price $8.00.

Power Plant Theory and Design. By Philip J. Potter. Published by The Ronald Press Co, 15 E 26th St, New York 10, N. Y. 678 pages, illustrated. Price $10.50.

Solid State Magnetic and Dielectric Devices. By Harold W. Katz. Published by John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y. 529 pages, illustrated. Price $13.50.

Evaluated Weather Data for Cooling Equipment Design. By Fluor Products Company, Whittier, California. 83 pages, illustrated. Price $35.00.

Engineering Economics for Professional Engineers' Examinations. By Max Kurtz. Published by McGraw-Hill Book Co Inc, 330 W 42nd St, New York 36, N. Y. 260 pages, illustrated. Price $6.50.

Handbook of Automation Computation and Control. By E. M. Grabbe, S. Ramo, and D. E. Wooldridge. Published by John Wiley & Sons Inc, 440 Fourth Ave, New York 16, N. Y. 800 pages, illustrated. Price $17.50.

Properties of Matter. By F. C. Champion and N. Davy. Published by Philosophical Library Inc, 15 E 40th St, New York 16, N. Y. 334 pages, illustrated. Price $10.00.

An Approach to Electrical Science. By Henry G. Booker. Published by McGraw-Hill Book Co Inc, 330 W 42nd St, New York 36, N. Y. 826 pages, illustrated. Price $9.50.

Programming Business Computers. By Daniel McCracken, Harold Weiss, and Tsai-Hwa Lee. Published by John Wiley & Sons, 440 Fourth Ave, New York, N. Y. 467 pages, illustrated. Price $10.25.

A-C Motor-Control Fundamentals. By R. L. McIntyre. Published by McGraw-Hill Book Co., 330 W 42nd St, New York 36, N. Y. 250 pages, illustrated. Price $6.95.

Fluorescent Lamps and Lighting. Edited by W. Elenbass. Published by Philips Technical Press, The Netherlands; distributed by the MacMillan Co, 60 Fifth Ave, New York, N. Y. 348 pages, illustrated. Price $11.00.

Letters to the Editor (*Continued from page 5*)

to agreement and review with TVA, a reputable U. S. agency, and in the State of Georgia, where we serve over 5,000 customers, with the Georgia Public Service Commission. (4) We give service to building developers as fast as we can with no regard as to whether the development is all-electric, although most of them are—in fact, over 90% because all-electric homes are in demand by buyers on account of cleanliness, efficiency and great owner satisfaction and pride in them. (5) We have no "fabulous" wiring allowances—in fact, we have none upon residential house heating and only a moderate one (as many utilities have) upon new commercial cooking installations; (6) We have no "guaranteed" heating costs and bill all of our customers upon our published rates. (7) The TVA-Chattanooga payroll, estimated at $10 million a year, has not made Chattanooga businessmen forget their free enterprise American heritage (Pres Eisenhower carried our County and State in 1952 and 1956). There are at least two payrolls in Chattanooga larger than TVA's.

Pahle's Chattanooga Gas Co does compete with us. Until I read his magazine article last week I thought they were doing a pretty good job of it. However, this is evidently not the case—in spite of their overspending us for sales promotion expenses during the last two years . . . Their reports to the Tennessee PUC show that in 1958 and 1959 they spent for sales promotion an average amount equal to 3.1% of their gross revenue, or $13.10 per meter. According to our published reports during the same period of time for the same type of sales promotion expenses, we spent only 2.5% of our gross revenue, or $5.36 per meter. . . .

It is a matter of record that occasionally customers change from one type of service to the other for their energy needs. However, when this happens, on our part we do not cry foul ball or shed tears, but just try to work at our business more industriously and arduously. . . .

S. R. Finley, Gen. Supt.
Electric Power Board of Chattanooga
Chattanooga, Tenn.

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Salary commensurate with experience and ability. Submit complete resume and salary desired.

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To work for internationally known engineering and consulting firm in Boston area. E.E. degree with 10 years experience in electric power field including system planning and familiarity with analog and digital machines relating to system faults, load flows and stability. Please forward resume including salary requirements to:

P-4118, Electrical World
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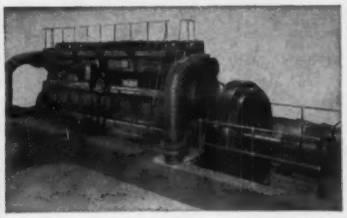

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375 kva General Motors model 268A
312 kva General Motors model 268A
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The Meetings Calendar

APRIL

American Institute of Electrical Engineers—Joint Automatic Techniques Conference, Sheraton-Cleveland Hotel, Cleveland, April 18-19; Great Lakes District Meeting, Hotel Pfister, Milwaukee, April 27-29.

Missouri Valley Electric Association—Engineering Conference, President Hotel & Municipal Auditorium, Kansas City, April 20-22.

Edison Electric Institute—Industrial Relations Committee joint with New England Regional Utility Group, Somerset Hotel, Boston, April 21-22; Accident Prevention Committee, Desert Ranch and Colonial Inn, St. Petersburg, Fla., April 24-27; EEI-AGA National Conference of Electric & Gas Utility Accountants, Commodore & Roosevelt Hotels, New York City, April 25-27; Statistical Committee, New Orleans, April 28-29.

Pennsylvania Electric Association—Communications Committee, Stanwix Hotel, Johnstown, April 21-22; Systems Operation Committee, Bedford Springs, April 28-29.

Electric Council of New England—Transmission and Distribution Committee, Hotel Northampton, Northampton, Mass., April 21-22.

Indiana Electric Association—Young Men's Utility Conference, Fort Wayne, Ind., April 21-22.

Illuminating Engineering Society—South Central-Southeastern Regional Conference, Peabody Hotel, Memphis, April 21-22; Southwestern Regional Conference, Robert Driscoll Hotel, Corpus Christi, April 25-26; Inter-Mountain Regional Conference, Mountain Shadows Hotel, Scotsdale, Ariz., April 28-29.

Rocky Mountain Electrical League—Annual Spring Conference, Harvest House, Boulder, Colo., April 24-27.

American Society of Mechanical Engineers—Maintenance & Plant Engineering Conference, Chase-Park Plaza Hotel, St. Louis, Mo., April 25-26; Metals Engineering Division-AWS Conference, Biltmore Hotel, Los Angeles, April 25-29.

Northwest Electric Light & Power Association—Engineering & Operations Section, Joint with Personnel & Safety Section, Hotel Florence, Missoula, Mont., April 27-29.

Western Air Conditioning, Heating, Ventilating & Refrigeration Exhibit & Conference—Shrine Exposition Hall, Los Angeles, April 27-30.

MAY

National Association of Electrical Distributors—52nd Annual Convention, Dallas, May 1-4.

Electrochemical Society—Spring Meeting, La Salle Hotel, Chicago, May 1-5.

• **Instrument Society of America**—Symposium on Electrical Safety Instrumentation, DuPont Country Club, Wilmington, Del., May 2-3; National Power Instrumentation Symposium, Brooks Hall, San Francisco, Calif., May 9-12.

• **Pennsylvania Electric Association**—System Planning Committee, Skytop, May 2-3; Electrical Equipment Committee, Skytop, May 5-6; Industrial Sales Conference, Skytop Club, Skytop, Pa., May 12-13; Joint Structures & Hydraulics & Prime Movers Committees, Dimeling Hotel, Clearfield, May 16-17; Relay Committee, Fort Stanwix Hotel, Johnstown, May 19-20; Transmission & Distribution Committees, Berkshire Hotel, Reading, May 19-20.

• **Edison Electric Institute**—Purchasing & Stores Committee, May 2-4; Second Financial Conference, La Salle Hotel, Chicago, May 9-11; Meter & Service Committee, May 22-25; Transmission & Distribution Committee, Penn Sheraton Hotel, Pittsburgh, May 12-13; Electrical System and Equipment Committee, Baker Hotel, Dallas, May 16-17.

• **American Institute of Electrical Engineers**—Northeastern District Meeting, Providence, R. I., May 2-4; Spring Textile Meeting, Georgia Institute of Technology, Atlanta, May 5-6; Farm Electrification Conference, Sheraton-Fontenelle Hotel, Omaha, May 10-12; Appliance Technical Meeting, Leland Hotel, Mansfield, Ohio, May 16-17; Electrical Problems in the Cement Industry, Pfister Hotel, Milwaukee, May 17-19.

• **Western Joint Computer Conference**—San Francisco, May 2-6.

• Additions this week.

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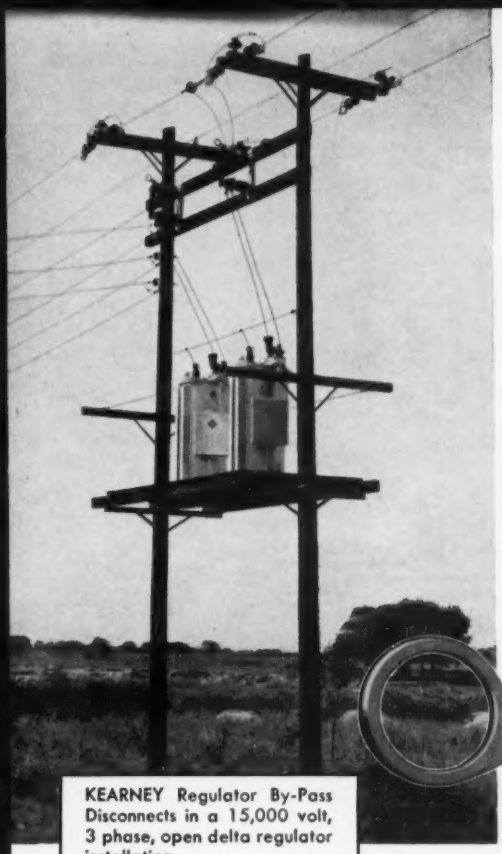

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